Technical Product Specification for Intel® Desktop Boards using the Intel® 845G Chipset

April 2002

Order Number: A81229-001

Intel® Desktop Boards using the Intel® 845G Chipset may contain design defects or errors known as errata that may cause the product to deviate from published specifications. Current characterized errata are documented in the Specification Update for Intel Desktop Boards using the Intel 845G Chipset.

Revision History

Revision	Revision History	Date
-001	First release of the Technical Product Specification for Intel® Desktop Boards using the Intel® 845G Chipset.	April 2002

This product specification applies to only standard Intel Desktop Boards using the Intel 845G Chipset with BIOS identifier RG84510.86A.

Changes to this specification will be published in the *Specification Update for Intel Desktop Boards using the Intel 845G Chipset* before being incorporated into a revision of this document.

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Preface

This Technical Product Specification (TPS) describes the features common to Intel Desktop Boards using the Intel 845G Chipset. This specification is to be used with Product Supplement documents (available separately) that describe features unique to individual members of the product family.

Intended Audience

The TPS is intended to provide detailed, technical information about Intel Desktop Boards using the Intel 845G Chipset and their components to the vendors, system integrators, and other engineers and technicians who need this level of information. It is specifically *not* intended for general audiences.

What This Document Contains

Chapter	Description
1	A description of the hardware used on these Intel Desktop boards
2	A description of the resources of the Desktop Boards
3	An overview of the BIOS Setup program
4	The contents of the BIOS Setup program's menus and submenus
5	A description of the BIOS error messages, beep codes, and POST codes

Typographical Conventions

This section contains information about the conventions used in this specification. Not all of these symbols and abbreviations appear in all specifications of this type.

Footnotes, Notes, Integrator's Notes, Cautions, and Warnings

Footnotes

Footnotes call attention to features that may not be standard or the implementation of which may vary depending on the Intel Desktop Board being used. Chapter 1 of each Product Supplement Document includes a footnote cross reference table.

NOTE

Notes call attention to important information.

INTEGRATOR'S NOTES

Integrator's notes are used to call attention to information that may be useful to system integrators.

CAUTION

Cautions are included to help you avoid damaging hardware or losing data.

WARNING

Warnings indicate conditions, which if not observed, can cause personal injury.

Other Common Notation

#	Used after a signal name to identify an active-low signal (such as USBP0#).
(NxnX)	When used in the description of a component, N indicates component type, xn are the relative coordinates of its location on the Desktop boards, and X is the instance of the particular part at that general location. For example, J5J1 is a connector, located at 5J. It is the first connector in the 5J area.
GB	Gigabyte (1,073,741,824 bytes)
GB/sec	Gigabytes per second
KB	Kilobyte (1024 bytes)
Kbit	Kilobit (1024 bits)
kbits/sec	1000 bits per second
MB	Megabyte (1,048,576 bytes)
MB/sec	Megabytes per second
Mbit	Megabit (1,048,576 bits)
Mbit/sec	Megabits per second
xxh	An address or data value ending with a lowercase h indicates a hexadecimal value.
x.x V	Volts. Voltages are DC unless otherwise specified.
†	This symbol is used to indicate third-party brands and names that are the property of their respective owners.

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1 Product Description

1.1 Overview

1.1.1 Feature Summary

Table 1 summarizes the major features.

Table 1. Feature Summary

Form Factors[1]	• ATX • microATX
Processor	• Support for an Intel® Pentium® 4 processor in a µPGA478 socket with a 400/533 MHz system bus • Support for an Intel® Celeron® processor in a µPGA478 socket with a 400 MHz system bus
Memory[2]	• Two DIMM sockets supporting one of the following: – 2.5 V (only) 184-pin 200/266 MHz Double Data Rate (DDR) SDRAM DIMMs with gold-plated contacts – 3.3 V (only) 168-pin 133 MHz Single Data Rate (SDR) SDRAM DIMMs with gold-plated contacts • Support for up to 2 GB system memory ***NOTE:*** *Desktop Boards using the Intel® 845G Chipset have been designed to support DIMMs based on 512 Mbit technology for a maximum onboard capacity of up to 2 GB, but this technology has not been validated.*
Chipset	Intel 845G Chipset, consisting of: • Intel® 82845G Graphics and Memory Controller Hub (GMCH) • Intel® 82801DB I/O Controller Hub (ICH4) • 4 Mbit Firmware Hub (FWH)
Audio[3]	Audio subsystem for AC '97 processing using the Analog Devices AD1981A codec

continued

[1] Form factors are product-dependent. For more information, refer to the Product Supplement Document for your Desktop Board.

[2] Memory support (DDR SDRAM or SDR SDRAM) is product-dependent. For more information, refer to the Product Supplement Document for your Desktop Board.

[3] Contact your Intel sales representative to determine if the audio subsystem is present on your Intel Desktop Board.

Table 1. Feature Summary (continued)

I/O Control	LPC Bus I/O controller (SMSC LPC47M172 or National Semiconductor PC87372)
Video	• Intel® Extreme Graphics controller • AGP connector supporting 1x, 2x, and 4x AGP cards (1.5 V only) or an AGP Digital Display (ADD) card • Integrated retention mechanism
Peripheral Interfaces	• Up to six USB ports • One serial port • One parallel port • Two IDE interfaces with UDMA 33, ATA-66/100 support • One diskette drive interface • PS/2† keyboard and mouse ports • Three fan connectors
Hardware Management Subsystem[4]	• Voltage sense to detect out of range power supply voltages • Thermal sense to detect out of range thermal values • Two fan sense inputs used to monitor fan activity • Fan speed control • Chassis intrusion detection • Hardware management ASIC
CNR[5]	One Communication and Networking Riser (CNR) connector
LAN[5]	Intel® 82562ET 10/100 Mbit/sec Platform LAN Connect (PLC) device
Instantly Available PC Technology	• Support for PCI Local Bus Specification Revision 2.2 • Suspend to RAM support • Wake on PCI, CNR, RS-232, front panel, PS/2 devices, and USB ports

For information about	Refer to
The board's compliance level with ACPI, Plug and Play, and SMBIOS	Section 1.4, page 13
Available configurations for Intel Desktop Boards using the Intel 845G Chipset	Section 1.2, page 12

NOTE

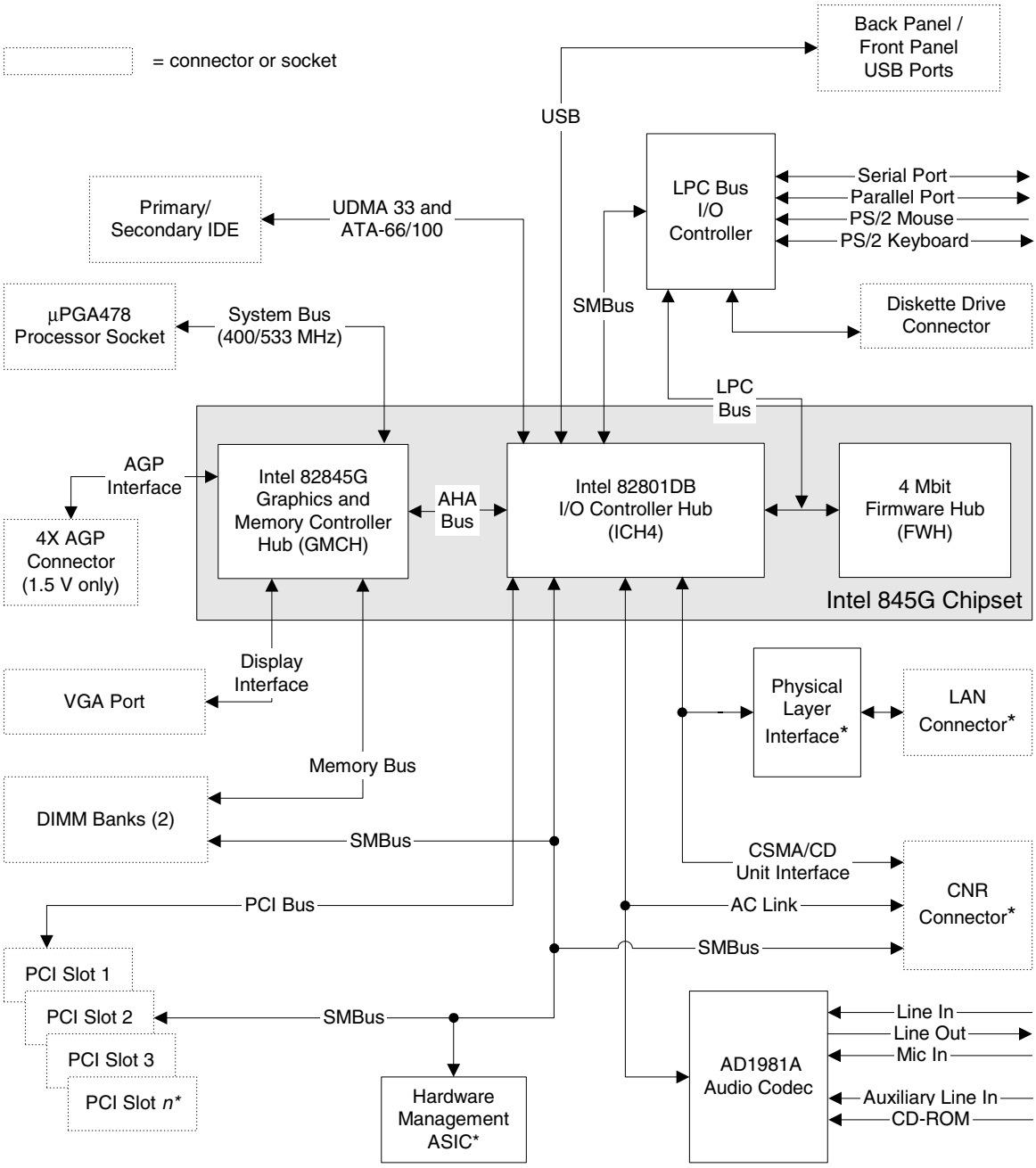
The LAN and the CNR features are mutually exclusive.

[4] Contact your Intel sales representative to determine which type of hardware monitoring ASIC is present on your Intel Desktop Board.

[5] The CNR connector and the LAN subsystem are mutually exclusive features. Contact your Intel sales representative to determine which of these features is present on your Intel Desktop Board.

1.1.2 Block Diagram

Figure 1 is a block diagram of the major functional areas of the Desktop Boards.



* For specific information on this feature, refer to the Product Supplement Document for your Desktop Board.

OM13570

Figure 1. Block Diagram

1.2 Online Support

To find information about…	Visit this World Wide Web site:
Intel Desktop Boards using the Intel 845G Chipset under “Product Info” or “Customer Support”	http://www.intel.com/design/motherbd http://support.intel.com/support/motherboards/desktop
Processor data sheets	http://www.intel.com/design/litcentr
ICH4 data sheet	http://developer.intel.com/design/chipsets/datashts
Custom splash screens	http://intel.com/design/motherbd/gen_indx.htm
Audio software and utilities	http://www.intel.com/design/motherbd
LAN software and drivers	http://www.intel.com/design/motherbd

1.3 Operating System Support

The Desktop Boards described in this document support drivers for all of the onboard hardware and subsystems under the following operating systems:

- Microsoft Windows† 98 SE
- Windows ME
- Windows NT† 4.0
- Windows 2000
- Windows XP

For information about	Refer to
Supported drivers	Section 1.2

NOTE

Third party vendors may offer other drivers.

NOTE

USB 2.0 support has been tested with Windows 2000 and Windows XP drivers and is not currently supported by any other operating system.

1.4 Design Specifications

Table 2 lists the specifications applicable to these Desktop Boards.

Table 2. Specifications

Reference Name	Specification Title	Version, Revision Date, and Ownership	The information is available from…
AC '97	*Audio Codec '97*	Revision 2.2, September 2000, Intel Corporation.	ftp://download.intel.com/ial/scalableplatforms/ac97r22.pdf
ACPI	*Advanced Configuration and Power Interface Specification*	Version 1.0b, July 01, 1998, Intel Corporation, Microsoft Corporation, and Toshiba Corporation.	http://www.acpi.info/spec10b.htm
AGP	*Accelerated Graphics Port Interface Specification*	Revision 2.0, May 4, 1998, Intel Corporation.	http://www.agpforum.org/specs_specs.htm
AMI BIOS[6]	*AMIBIOS Desktop Core 7.0*	AMIBIOS 7.0, August 8, 2001, American Megatrends, Inc.	http://www.ami.com/support/doc/amibiosdesktop.pdf
ATA/ ATAPI-5	*Information Technology-AT Attachment with Packet Interface - 5* (ATA/ATAPI-5)	Revision 3, February 29, 2000, Contact: T13 Chair, Seagate Technology.	http://www.t13.org
ATX	*ATX Specification*	Version 2.03, December 1998, Intel Corporation.	http://www.formfactors.org/developer/specs/atx/atxspecs.htm
ATX12V Power Supply	*ATX/ATX12V Power Supply Design Guide*	Version 1.2, August 2000, Intel Corporation.	http://www.formfactors.org/developer/specs/atx/atxspecs.htm
BIS	Boot Integrity Services (BIS) Application Programming Interface (API)	Version 1.0 August 4, 1999, Intel Corporation.	http://www.intel.com/labs/manage/wfm/wfmspecs.htm
CNR	*Communication and Network Riser (CNR) Specification*	Revision 1.2, November 8, 2001, Intel Corporation.	http://developer.intel.com/technology/cnr/index.htm

continued

[6] Some Desktop Boards may use a different BIOS core. For more information, refer to the Product Supplement Document for your Desktop Board.

Table 2. Specifications (continued)

Reference Name	Specification Title	Version, Revision Date and Ownership	The information is available from…
DDR SDRAM[7]	*Double Data Rate (DDR) SDRAM Specification*	Version 1.0, June 2000, JEDEC Solid State Technology Association.	http://www.jedec.org/
	Design Specification for a 184 Pin DDR Unbuffered DIMM	Revision 1.0, October 2001, JEDEC Solid State Technology Association.	http://www.jedec.org/
	Intel® JEDEC DDR 200/266 Unbuffered DIMM Specification Addendum	Revision 0.9, September 27, 2001, Intel Corporation.	http://developer.intel.com/technology/memory/index.htm
DVI	*Digital Visual Interface (DVI) Specification*	Revision 1.0, April 02, 1999, Digital Display Working Group.	http://www.ddwg.org/downloads.html
EHCI	*Enhanced Host Controller Interface Specification for Universal Serial Bus*	Revision 1.0, March 12, 2002, Intel Corporation.	http://developer.intel.com/technology/usb/download/ehci-r10.pdf
EPP	*IEEE Std 1284.1-1997* (Enhanced Parallel Port)	Version 1.7, 1997, Institute of Electrical and Electronic Engineers.	http://standards.ieee.org/reading/ieee/std_public/description/busarch/1284.1-1997_desc.html
El Torito	*Bootable CD-ROM Format Specification*	Version 1.0, January 25, 1995, Phoenix Technologies Limited and International Business Machines Corporation.	http://www.phoenix.com/PlatSS/products/specs.html
Front Panel	*Front Panel I/O Connectivity Design Guide*	Version 1.0, October 2000, Intel Corporation.	http://www.formfactors.org/formfactors/front_panel_io.htm
LPC	*Low Pin Count Interface Specification*	Revision 1.0, September 29, 1997, Intel Corporation.	http://www.intel.com/design/chipsets/industry/lpc.htm
microATX	*microATX Motherboard Interface Specification*	Version 1.0, December 1997, Intel Corporation.	http://www.formfactors.org/developer/specs/microatx/microatxspecs.htm

continued

[7] Memory support (DDR SDRAM or SDR SDRAM) is product-dependent. For more information, refer to the Product Supplement Document for your Desktop Board.

Table 2. Specifications (continued)

Reference Name	Specification Title	Version, Revision Date and Ownership	The information is available from…
PCI	*PCI Local Bus Specification*	Revision 2.2, December 18, 1998, PCI Special Interest Group.	http://www.pcisig.com/specifications
	PCI Bus Power Management Interface Specification	Revision 1.1, December 18, 1998, PCI Special Interest Group.	http://www.pcisig.com/specifications
Plug and Play	*Plug and Play BIOS Specification*	Version 1.0a, May 5, 1994, Compaq Computer Corporation, Phoenix Technologies Limited, and Intel Corporation.	http://www.microsoft.com/hwdev/respec/pnpspecs.htm
PXE	*Preboot Execution Environment*	Version 2.1, September 20, 1999, Intel Corporation.	ftp://download.intel.com/ial/wfm/pxespec.pdf
SDRAM[8]	*PC SDRAM Unbuffered DIMM Specification*	Revision 1.0, February 1998, Intel Corporation.	http://www.intel.com/technology/memory
	PC SDRAM Specification	Revision 1.7, November 1999, Intel Corporation.	http://www.intel.com/technology/memory
	PC Serial Presence Detect (SPD) Specification	Revision 1.2B, November 1999, Intel Corporation.	http://www.intel.com/technology/memory
SFX12V Power Supply	*SFX/SFX12V Power Supply Design Guide*	Revision 2.0, May 2001, Intel Corporation.	http://www.formfactors.org/developer/specs/sfx/sfx12v.pdf
SMBIOS	*System Management BIOS*	Version 2.3.1, March 16, 1999, American Megatrends Incorporated, Award Software International Incorporated, Compaq Computer Corporation, Dell Computer Corporation, Hewlett-Packard Company, Intel Corporation, International Business Machines Corporation, Phoenix Technologies Limited, and SystemSoft Corporation.	http://www.dmtf.org/download/standards/DSP0119.pdf

continued

[8] Memory support (DDR SDRAM or SDR SDRAM) is product-dependent. For more information, refer to the Product Supplement Document for your Desktop Board.

Table 2. Specifications (continued)

Reference Name	Specification Title	Version, Revision Date and Ownership	The information is available from…
UHCI	*Universal Host Controller Interface Design Guide*	Revision 1.1, March 1996, Intel Corporation.	http://www.usb.org/developers/docs.html
USB	*Universal Serial Bus Specification*	Revision 1.1, September 23, 1998, Compaq Computer Corporation, Intel Corporation, Microsoft Corporation, and NEC Corporation.	http://www.usb.org/developers/docs.html
		Revision 2.0, April 27, 2000, Compaq Computer Corporation, Hewlett-Packard Company, Lucent Technologies Inc., Intel Corporation, Microsoft Corporation, NEC Corporation, and Koninklijke Philips Electronics N.V.	http://www.usb.org/developers/docs.html
WfM	*Wired for Management Baseline*	Version 2.0, December 18, 1998, Intel Corporation.	http://www.intel.com/labs/manage/wfm/wfmspecs.htm

1.5 Processor

CAUTION

Use of unsupported processors can damage the Desktop Board, the processor, and the power supply. See the Specification Update for Intel® Desktop Boards using the Intel 845G Chipset *for the most up-to-date list of supported processors for these boards.*

The Desktop Boards support the following[9]:

- A Pentium 4 processor in a µPGA478 socket with a system bus of 400/533 MHz
- A Celeron processor in a µPGA478 socket with a system bus of 400 MHz

All supported onboard memory can be cached. See the processor's data sheet for cachability limits.

INTEGRATOR'S NOTES

- *Use only ATX12V- or SFX12V-compliant power supplies with these Desktop Boards. ATX12V and SFX12V power supplies have an additional power lead that provides required supplemental power for the processor. Always connect the 20-pin and 4-pin leads of ATX12V and SFX12V power supplies to the corresponding connectors on the Desktop Boards, otherwise the board will not boot.*
- *Do not use a standard ATX power supply. The board will not boot with a standard ATX power supply.*

For information about	Refer to
Processor support	Section 1.2, page 12
Processor usage	Section 1.2, page 12

[9] Processor support is product-dependent. For more information, refer to the Product Supplement Document for your Desktop Board.

1.6 System Memory

The Desktop Boards provide the following memory features:

- Two DIMM sockets supporting one of the following[10]:
  - 2.5 V (only) 184-pin 200/266 MHz Double Data Rate (DDR) SDRAM DIMMs with gold-plated contacts, or
  - 3.3 V (only) 168-pin 133 MHz Single Data Rate (SDR) SDRAM DIMMs with gold-plated contacts
- Unbuffered non-ECC DIMMs only
- Maximum total system memory: 2 GB; minimum total system memory: 64 MB
- Serial Presence Detect (SPD) DIMMs only
- Suspend to RAM

CAUTION

Do not use ECC DIMMs with these Desktop Boards. Using ECC DIMMs could damage the Desktop Board.

INTEGRATOR'S NOTES

- *Registered DIMMs are not supported on these Desktop Boards.*
- *Remove the AGP video card before installing or upgrading memory to avoid interference with the memory retention mechanism.*
- *These Desktop Boards have been designed to support DIMMs based on 512 Mbit technology for a maximum onboard capacity of up to 2 GB, but this technology has not been validated on this board.*

NOTE

To be fully compliant with all applicable DDR SDRAM and PC133 SDRAM memory specifications, the board should be populated with DIMMs that support the Serial Presence Detect (SPD) data structure. This allows the BIOS to read the SPD data and program the chipset to accurately configure memory settings for optimum performance.

For information about	Refer to
Obtaining DDR SDRAM specifications	Section 1.4, page 13
Obtaining the PC Serial Presence Detect (SPD) Specification	Section 1.4, page 13

[10] Memory support (DDR SDRAM or SDR SDRAM) is product-dependent. For more information, refer to the Product Supplement Document for your Desktop Board.

Table 3 lists the supported DDR DIMM configurations.

Table 3. Supported DDR DIMM Configurations

DIMM Capacity	Configuration (Note)	DDR SDRAM Density	DDR SDRAM Organization Front-side/Back-side	Number of DDR SDRAM Devices
32 MB	SS	64 Mbit	4 M x 16/empty	4
64 MB	SS	64 Mbit	8 M x 8/empty	8
64 MB	SS	128 Mbit	8 M x 16/empty	4
128 MB	DS	64 Mbit	8 M x 8/8 M x 8	16
128 MB	SS	128 Mbit	16 M x 8/empty	8
128 MB	SS	256 Mbit	16 M x 16/empty	4
256 MB	DS	128 Mbit	16 M x 8/16 M x 8	16
256 MB	SS	256 Mbit	32 M x 8/empty	8
512 MB	DS	256 Mbit	32 M x 8/32 M x 8	16

Note: In this column, “DS” refers to double-sided memory modules (containing DDR SDRAM devices on both sides) and “SS” refers to single-sided memory modules (containing DDR SDRAM devices on only one side).

Table 4 lists the supported SDR DIMM configurations.

Table 4. Supported SDR DIMM Configurations

DIMM Capacity	Configuration (Note)	SDR SDRAM Density	SDR SDRAM Organization Front-side/Back-side	Number of SDR SDRAM devices
32 MB	SS	64 Mbit	4 M x 16/empty	4
64 MB	DS	64 Mbit	4 M x 16/4 M x 16	8
64 MB	SS	64 Mbit	8 M x 8/empty	8
64 MB	SS	128 Mbit	8 M x 16/empty	4
128 MB	DS	64 Mbit	8 M x 8/8 M x 8	16
128 MB	DS	128 Mbit	8 M x 16/8 M x 16	8
128 MB	SS	128 Mbit	16 M x 8/empty	8
128 MB	SS	256 Mbit	16 M x 16/empty	4
256 MB	DS	128 Mbit	16 M x 8/16 M x 8	16
256 MB	DS	256 Mbit	16 M x 16/16 M x 16	8
256 MB	SS	256 Mbit	32 M x 8/empty	8
512 MB	DS	256 Mbit	32 M x 8/32 M x 8	16

Note: In this column, “DS” refers to double-sided memory modules (containing SDR SDRAM devices on both sides) and “SS” refers to single-sided memory modules (containing SDR SDRAM devices on only one side).

1.7 Intel® 845G Chipset

The Intel 845G chipset consists of the following devices:

- Intel 82845G Graphics and Memory Controller Hub (GMCH) with Accelerated Hub Architecture (AHA) bus
- Intel 82801DB I/O Controller Hub (ICH4) with AHA bus
- 4 Mbit Firmware Hub (FWH)

The GMCH is a centralized controller for the system bus, the memory bus, the AGP bus, and the Accelerated Hub Architecture interface. The ICH4 is a centralized controller for the board's I/O paths. The FWH provides the nonvolatile storage of the BIOS.

For information about	Refer to
The Intel 845G chipset	http://developer.intel.com
Resources used by the chipset	Chapter 2

1.7.1 Intel 845G Graphics Subsystem

The Intel 845G chipset contains two separate, mutually exclusive graphics options. Either the Intel Extreme Graphics controller (contained within the 82845G GMCH) is used, or an AGP add-in card can be used. When an AGP add-in card is installed, the Intel Extreme Graphics controller is disabled.

1.7.1.1 Intel® Extreme Graphics Controller

The Intel Extreme Graphics controller features the following:

- Integrated graphics controller
  - 32 bpp (Bits Per Pixel) graphics engine
  - 200 MHz core frequency
  - 256-bit internal data path for 2-D and 3-D graphics
  - Motion video acceleration
- 3-D graphics visual and texturing enhancement
- Display
  - Integrated 24-bit 350 MHz RAMDAC
  - DDC2B compliant interface
- Video
  - Dual monitor synchronous display
  - Hardware motion compensation for software MPEG2 decode
  - Two multiplexed DVO port interfaces with 165 MHz pixel clocks using an AGP Digital Display (ADD) card
- Dynamic Video Memory Technology (DVMT) support up to 64 MB (driver dependent)

For information about	Refer to
DVMT	Section 1.7.1.2, page 24

INTEGRATOR'S NOTE

EMC emission testing of high-speed video was performed on this Desktop Board using scrolling H's displayed on the video monitor in accordance with ANSI C63.4-2000 documentation. The scrolling H's are displayed using the following font sizes:

- *For video resolutions greater than 1600 x 1200 (including 2048 x 1536 and 1920 x 1440), a font size of 200% is used.*
- *For a 1600 x 1200 video resolution, a 150% font size is used.*
- *For resolutions less than 1600 x 1200, a normal or large font size is used.*

All available resolutions are tested using the highest available color depth and monitor refresh rate.

Table 5 lists the Direct Draw supported modes.

Table 5. Direct Draw Supported Modes

Resolution	Color Palette	Refresh Frequency (Hz)	Notes
320 x 200	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3
320 x 240	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3
352 x 480	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3
352 x 576	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3
400 x 300	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3
512 x 384	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3
640 x 400	256 colors	70	Y
	64 K colors	70	3
	16 M colors	70	3

Notes: Y = Supported in driver without Direct3D† and OpenGL†
3 = Direct3D and OpenGL

Table 6 lists the video BIOS video modes supported by the graphics subsystem.

Table 6. Video BIOS Video Modes Supported for Analog CRTs

Resolution	Color Palette	Available Refresh Frequencies (Hz)	Notes
320 x 200	16 colors	70	T, G, B
	256 colors	70	G, B
320 x 350	16 colors	70	T, B
360 x 400	16 colors	70	T, B
640 x 200	16 colors	70	T, G, B
640 x 350	16 colors	70	T, G, B
640 x 480	16 colors	60	G, B
	256 colors	60, 75, 85	G, B, L
	64 K colors	60, 75, 85	G, B, L
	16 M colors	60, 75, 85	G, B, L
720 x 400	16 colors	70	T, B
800 x 600	256 colors	60, 75, 85	G, B, L
	64 K colors	60, 75, 85	G, B, L
	16 M colors	60, 75, 85	G, B, L
1024 x 768	256 colors	60, 75, 85	G, B, L
	64 K colors	60, 75, 85	G, B, L
	16 M colors	60, 75, 85	G, B, L
1056 x 350	16 colors	70	T, B
1056 x 400	16 colors	70	T, B
1056 x 480	16 colors	70	T, B
1280 x 1024	256 colors	60, 75, 85	G, B, L
	64 K colors	60, 75, 85	G, B, L
	16 M colors	60, 75, 85	G, B, L
1600 x 1200	256 colors	60, 75, 85	G, B, L
	64 K colors	60, 75, 85	G, B, L
	16 M colors	60, 75, 85	G, B, L
1920 x 1440	256 colors	60, 75	G, B, L
	64 K colors	60, 75	G, B, L

Notes: T = Text mode
G = Graphics mode
B = Banked addressing mode
L = Linear addressing mode

Table 7 lists the supported configuration modes of the graphics subsystem.

Table 7. Supported Configuration Modes

Resolution	Available Refresh Frequencies (Hz)	Supported bpp Configuration Mode (see Table 8 for more information)
640 x 480	60, 72, 75, 85, 100, 120	6
800 x 600	60, 72, 75, 85, 100, 120	6
1024 x 768	60, 70, 75, 85, 100	6
1024 x 768	120	5
1152 x 864	60, 75, 85	6
1152 x 864	100	5
1280 x 720	60, 75, 85	6
1280 x 720	100	5
1280 x 768	Reduced blanking	6
1280 x 960	60, 75	6
1280 x 960	85	5
1280 x 1024	60	6
1280 x 1024	75	5
1280 x 1024	85, 100	4
1280 x 1024	120	3
1400 x 1050	60	6
1600 x 900	60	6
1600 x 900	75, 85	4
1600 x 900	100	3
1600 x 1200	60	4
1600 x 1200	75, 85, 100	3
1856 x 1392	60, 75	3
1920 x 1080	60	4
1920 x 1080	75, 85	3
1920 x 1200	60	3
1920 x 1440	60, 75	3
2048 x 1536	60	3

Table 8 describes the bpp configuration mode values referenced in Table 7. In Table 8, assume that for each configuration mode number, the features of all lower numbers are also supported. For example, if the supported configuration mode is 4, then modes 1 through 3 are also supported. DVD consists of both the overlay engine as well as the MPEG decoding; both are necessary for DVD playback.

Table 8. Details of bpp Configuration Modes

Configuration Mode Number	Description
6	32 bpp (16 M colors) with DVD (Overlay + MPEG decode) On
5	16 bpp (64 K colors) with DVD On
4	32 bpp (16 M colors) with DVD Off
3	16 bpp (64 K colors) with DVD Off
2	8 bpp (256 colors) with DVD On
1	8 bpp (256 colors) with DVD off

For information about	Refer to
Obtaining graphics software and utilities	Section 1.2, page 12

1.7.1.2 Dynamic Video Memory Technology (DVMT)

DVMT enables enhanced graphics and memory performance through Direct AGP, and highly efficient memory utilization. DVMT ensures the most efficient use of available system memory (up to 64 MB) for maximum 2-D/3-D graphics performance.

DVMT uses a portion of system physical memory (as set in the BIOS Setup program) for compatibility with legacy applications. An example of this would be when using VGA graphics under DOS. Once loaded, the operating system and graphics drivers allocate the buffers needed for performing graphics functions.

NOTE

The use of DVMT requires operating system driver support.

For information about	Refer to
Obtaining the DVMT white paper	http://developer.intel.com/design/chipsets/845g/

1.7.1.3 Zone Rendering Technology (ZRT)

The Intel Extreme Graphics Controller supports Zone Rendering Technology (ZRT). ZRT is a process by which the screen is divided into several zones. Each zone is completely cached and rendered on chip before being written to the frame buffer. The benefits of ZRT include the following:

- Increased memory efficiency via better localization of data
- Increased on-chip processing speed due to decreased wait time for data
- Increased effective pixel fill rates

- Increased headroom for larger resolution and color depth
- Reduced power as a result of decreased memory bandwidth
- Reduction in depth and color bandwidth associated with conventional rendering

For information about	Refer to
Obtaining the Zone Rendering white paper	http://developer.intel.com/design/chipsets/845g/

1.7.1.4 AGP Connector

The AGP connector supports either:

- 1x, 2x, or 4x AGP add-in cards with 1.5 V I/O
- AGP Digital Display (ADD) cards

For information about	Refer to
Obtaining the *Accelerated Graphics Port Interface Specification*	Section 1.4, page 13

INTEGRATOR'S NOTES

- *Install memory in the DIMM sockets prior to installing the AGP video card to avoid interference with the memory retention mechanism.*
- *The AGP connector is keyed for 1.5 V AGP cards only. Do not attempt to install a legacy 3.3 V AGP card. The AGP connector is not mechanically compatible with legacy 3.3 V AGP cards.*

1.7.1.5 AGP Digital Display (ADD) Card Support

The GMCH routes two 12-bit multiplexed DVO ports that are each capable of driving a 165 MHz pixel clock to the AGP connector. The DVO ports can be paired for dual channel mode. In dual channel mode, the GMCH is capable of driving a 24-bit 330 MHz pixel clock. When an AGP add-in card is used, the Intel Extreme Graphics controller is disabled and the AGP connector operates in AGP mode. When an ADD card is detected, the Intel Extreme Graphics controller is enabled and the AGP connector is configured for DVO mode. DVO mode enables the DVO ports to be accessed by an ADD card. ADD cards can support up to two display devices with the following configurations:

- TV-Out
- Transition Minimized Differential Signaling (TMDS)
- Low Voltage Differential Signaling (LVDS)
- Single device operating in dual channel mode

INTEGRATOR'S NOTES

- *Synchronous display is not supported when one of the display devices is a TV.*
- *Digital Visual Interface (DVI) support is present only when an ADD card is installed.*

1.7.2 USB

The Desktop Boards support up to six USB 2.0 ports, fully support UHCI and EHCI, and use UHCI- and EHCI-compatible drivers. For more than six USB devices, an external hub can be connected to any of the ports.

The ICH4 provides the USB controller for all ports. The port arrangement is as follows:

- Two ports are implemented with stacked back panel connectors, adjacent to the PS/2 connectors
- Two ports are implemented with stacked back panel connectors, adjacent to the audio connectors
- Two ports are routed to the front panel USB connector

NOTE

Computer systems that have an unshielded cable attached to a USB port may not meet FCC Class B requirements, even if no device is attached to the cable. Use shielded cable that meets the requirements for full-speed devices.

NOTE

USB 2.0 support has been tested with Windows 2000 and Windows XP drivers and is not currently supported by any other operating system.

1.7.3 IDE Support

1.7.3.1 IDE Interfaces

The ICH4's IDE controller has two independent bus-mastering IDE interfaces that can be independently enabled. The IDE interfaces support the following modes:

- Programmed I/O (PIO): processor controls data transfer.
- 8237-style DMA: DMA offloads the processor, supporting transfer rates of up to 16 MB/sec.
- Ultra DMA: DMA protocol on IDE bus supporting host and target throttling and transfer rates of up to 33 MB/sec.
- ATA-66: DMA protocol on IDE bus supporting host and target throttling and transfer rates of up to 66 MB/sec. ATA-66 protocol is similar to Ultra DMA and is device driver compatible.
- ATA-100: DMA protocol on IDE bus allows host and target throttling. The ICH4's ATA-100 logic can achieve transfer rates up to 100 MB/sec.

INTEGRATOR'S NOTE

ATA-66 and ATA-100 are faster timings and require a specialized cable to reduce reflections, noise, and inductive coupling.

The IDE interfaces also support ATAPI devices (such as CD-ROM drives) and ATA devices.

The BIOS supports 48-bit Logical Block Addressing (LBA) and Extended Cylinder Head Sector (ECHS) translation modes. The drive reports the transfer rate and translation mode to the BIOS.

The Desktop Boards support Laser Servo (LS-120) diskette technology through the IDE interfaces. The BIOS supports booting from an LS-120 drive.

NOTE

The BIOS will always recognize an LS-120 drive as an ATAPI floppy drive. To ensure correct operation, do not configure the drive as a hard disk drive.

1.7.3.2 SCSI Hard Drive Activity LED Connector

The SCSI hard drive activity LED connector is a 1 x 2-pin connector that enables an add-in SCSI controller to use the same LED as the onboard IDE controller. For proper operation, this connector should be wired to the LED output of the add-in SCSI controller. The LED indicates when data is being read from, or written to, both the add-in SCSI controller and the IDE controller.

1.7.4 Real-Time Clock, CMOS SRAM, and Battery

A coin-cell battery (CR2032) powers the real-time clock and CMOS memory. When the computer is not plugged into a wall socket, the battery has an estimated life of three years. When the computer is plugged in, the standby current from the power supply extends the life of the battery. The clock is accurate to ± 13 minutes/year at 25 ºC with 3.3 VSB applied.

INTEGRATOR'S NOTE

If the battery and AC power fail, custom defaults, if previously saved, will be loaded into CMOS RAM at power-on.

1.8 I/O Controller

The I/O controller (SMSC LPC47M172 or National Semiconductor PC87372) provides the following features:

- One serial port
- One parallel port with Extended Capabilities Port (ECP) and Enhanced Parallel Port (EPP) support
- Serial IRQ interface compatible with serialized IRQ support for PCI systems
- PS/2-style mouse and keyboard interfaces
- Interface for one 1.2 MB or 1.44 MB diskette drive
- Intelligent power management, including a programmable wake-up event interface
- PCI power management support
- Two fan tachometer inputs

The BIOS Setup program provides configuration options for the I/O controller.

For information about	Refer to
SMSC LPC47M172 I/O controller	http://www.smsc.com
National Semiconductor PC87372 I/O controller	http://www.natsemi.com

1.8.1 Serial Port

The Desktop Board has one serial port connector, for Serial port A, located on the back panel. The serial port supports data transfers at speeds up to 115.2 kbits/sec with BIOS support.

1.8.2 Parallel Port

The 25-pin D-Sub parallel port connector is located on the back panel. Use the BIOS Setup program to set the parallel port mode.

1.8.3 Diskette Drive Controller

The I/O controller supports one diskette drive. Use the BIOS Setup program to configure the diskette drive interface.

1.8.4 Keyboard and Mouse Interface

PS/2 keyboard and mouse connectors are located on the back panel.

INTEGRATOR'S NOTE

The keyboard is supported in the bottom PS/2 connector and the mouse is supported in the top PS/2 connector. Power to the computer should be turned off before a keyboard or mouse is connected or disconnected.

1.9 Audio Subsystem

The audio subsystem consists of the following devices:

- Intel 82801DB I/O Controller Hub (ICH4)
- Analog Devices AD1981A audio codec

The audio subsystem includes these features[11]:

- Split digital/analog architecture for improved S/N (signal-to-noise) ratio: ≥ 85 dB
- Power management support for ACPI 2.0 (driver dependant)
- Mic in pre-amp that supports dynamic, condenser, and electret microphones

The audio subsystem supports the following audio interfaces:

- ATAPI-style connectors:
  - Auxiliary line in
  - CD-ROM

[11] Contact your Intel sales representative to determine if the audio subsystem is present on your Intel Desktop Board.

- Front panel audio connector, including pins for:
  - Line out
  - Mic in
- Back panel audio connectors:
  - Line out
  - Line in
  - Mic in

For information about	Refer to
Upgrading the onboard audio subsystem using a CNR audio card	Section 1.11, page 31

1.9.1 Audio Connectors

1.9.1.1 Front Panel Audio Connector

A 2 x 5-pin connector provides mic in and line out signals for front panel audio connectors[12].

For information about	Refer to
Obtaining the *Front Panel I/O Connectivity Design Guide*	Section 1.4, page 13

1.9.1.2 Auxiliary Line In Connector

A 1 x 4-pin ATAPI-style connector connects the left and right channel signals of an internal audio device to the audio subsystem.

1.9.1.3 ATAPI CD-ROM Audio Connector

A 1 x 4-pin ATAPI-style connector connects an internal ATAPI CD-ROM drive to the audio mixer.

1.9.2 Audio Subsystem Software

Audio software and drivers are available from Intel's World Wide Web site.

For information about	Refer to
Obtaining audio software and drivers	Section 1.2, page 12

[12] The front panel audio connector can also be used as a jumper block for routing audio signals. For more information about the configurations of this connector, refer to the Product Supplement Document for your Desktop Board.

1.10 LAN Subsystem

The Network Interface Controller subsystem consists of the ICH4 (with integrated LAN Media Access Controller) and a physical layer interface device. Features of the LAN subsystem include[13]:

- PCI Bus Master interface
- CSMA/CD Protocol Engine
- Serial CSMA/CD unit interface that supports the 82562ET (10/100 Mbit/sec Ethernet) on the CNR bus
- PCI Power Management
  - Supports ACPI technology
  - Supports LAN wake capabilities

1.10.1 Intel® 82562ET Platform LAN Connect Device

The Intel 82562ET component provides an interface to the back panel RJ-45 connector with integrated LEDs. This physical interface may alternately be provided through the CNR connector.

The Intel 82562ET provides the following functions:

- Basic 10/100 Ethernet LAN connectivity
- Supports RJ-45 connector with status indicator LEDs on the back panel
- Full device driver compatibility
- ACPI support
- Programmable transit threshold
- EEPROM that contains the MAC address

1.10.2 RJ-45 LAN Connector with Integrated LEDs

Two LEDs are built into the RJ-45 LAN connector. Table 9 describes the LED states when the board is powered up and the LAN subsystem is operating.

Table 9. LAN Connector LED States

LED Color	LED State	Condition
Green	Off	10 Mbit/sec data rate is selected.
	On	100 Mbit/sec data rate is selected.
Yellow	Off	LAN link is not established.
	On (steady state)	LAN link is established.
	On (brighter and pulsing)	The computer is communicating with another computer on the LAN.

[13] The CNR connector and the LAN subsystem are mutually exclusive features. Contact your Intel sales representative to determine which of these features is present on your Intel Desktop Board.

1.10.3 LAN Subsystem Software

LAN software and drivers are available from Intel's World Wide Web site.

For information about	Refer to
Obtaining LAN software and drivers	Section 1.2, page 12

1.11 CNR

The CNR connector provides an interface that supports the audio, modem, and LAN interfaces of the Intel 845G chipset[14]. The interfaces supported by the CNR include the following:

- AC '97 interface: supports audio and/or modem functions on the CNR card.
- LAN interfaces: supports Platform LAN Connection (PLC) based devices through an eight-pin interface
- SMBus interface: provides Plug-and-Play functionality for the CNR card.

The CNR connector includes power signals required for power management and for CNR card operation. To learn more about the CNR, refer to the CNR specification.

The onboard two-channel audio subsystem can be upgraded to four- or six-channel audio using a CNR audio upgrade card in a slave configuration. CNR audio upgrade cards are available in multiple configurations from several vendors supporting analog or S/P-DIF digital connections.

For information about	Refer to
CNR audio upgrade cards	http://developer.intel.com/technology/cnr/

INTEGRATOR'S NOTES

- *If you install a CNR card that cannot support a multichannel audio upgrade, the Desktop Boards' integrated audio codec will be disabled. This only applies to Desktop Boards that have both the onboard audio subsystem and a CNR connected.*
- *The brand and type of audio codec used on the CNR card must match that of the Desktop Boards' codec (Analog Devices AD1981A).*
- *Check with your CNR vendor to ensure that the CNR card has been tested with ICH4-based systems.*
- *There is no USB interface routed to the CNR connector.*

For information about	Refer to
Obtaining the CNR specification	Section 1.4, page 13

[14] The CNR connector and the LAN subsystem are mutually exclusive features. Contact your Intel sales representative to determine which of these features is present on your Intel Desktop Board.

1.12 Hardware Management Subsystem

The hardware management features enable the boards to be compatible with the Wired for Management (WfM) specification. The board has several hardware management features, including the following:

- Fan monitoring and control (through the I/O controller or the Hardware monitoring and fan control ASIC)
- Thermal and voltage monitoring
- Chassis intrusion detection

For information about	Refer to
The WfM specification	Section 1.4, page 13

1.12.1 Hardware Monitoring ASICs

The Desktop Boards provide one of the following[15]:

- A hardware monitoring ASIC
- A hardware monitoring and fan control ASIC

The features of these components are described in this section.

1.12.1.1 Hardware Monitoring ASIC

The features of the hardware monitoring ASIC (Analog Devices ADM1025, Philips Semiconductor NE1619, or equivalent) include:

- Internal ambient temperature sensor
- Remote thermal diode sensor for direct monitoring of processor temperature
- Power supply monitoring of four voltages (+5 V, +3.3 V, +2.5 V, and +VCCP1) to detect levels above or below acceptable values
- SMBus interface

For information about	Refer to
The Analog Devices ADM1025	http://www.analogdevices.com
The Philips Semiconductor NE1619	http://www.philipssemiconductor.com

[15] Contact your Intel sales representative to determine which type of hardware monitoring ASIC is present on your Intel Desktop Board.

1.12.1.2 Hardware Monitoring and Fan Control ASIC

The features of the hardware monitoring and fan control ASIC (Analog Devices ADM1027, National Semiconductor LM85, Standard Microsystems SMSC EMC6D101, or equivalent) include:

- Internal ambient temperature sensor
- Two remote thermal diode sensors for direct monitoring of processor temperature and ambient temperature sensing
- Power supply monitoring of five voltages (+5 V, +12 V, +3.3 V, +2.5 V, and +VCCP1) to detect levels above or below acceptable values
- Fan monitoring for all three fans
- Thermally monitored closed-loop fan control, for all three fans, that can adjust the fan speed or switch the fans on or off as needed
- SMBus interface

For information about	Refer to
The Analog Devices ADM1027	http://www.analogdevices.com
The National Semiconductor LM85	http://www.national.com
The Standard Microsystems SMSC EMC6D101	http://www.smsc.com

1.12.2 Fan Monitoring

Fan monitoring can be implemented using Intel® Active Monitor, Intel® LANDesk® Client Manager, or third-party software. The level of fan monitoring and control is dependent on the hardware monitoring ASIC used[16] with the Desktop Board.

For information about	Refer to
The functions of the fan connectors	Section 1.13.2.2, page 37

1.12.3 Chassis Intrusion and Detection

The Desktop Boards support a chassis security feature that detects if the chassis cover is removed. For the chassis intrusion circuit to function, the chassis' power supply must be connected to AC power. The security feature uses a mechanical switch on the chassis that attaches to the chassis intrusion connector. The mechanical switch is open for normal computer operation.

NOTE

Chassis intrusion detection may be implemented using Intel LANDesk Client Manager or third-party software.

[16] Contact your Intel sales representative to determine which type of hardware monitoring ASIC is present on your Intel Desktop Board.

1.13 Power Management

Power management is implemented at several levels, including:

- Software support through Advanced Configuration and Power Interface (ACPI)
- Hardware support:
  - Power connector
  - Fan connectors
  - LAN wake capabilities
  - Instantly Available PC technology
  - Resume on Ring
  - Wake from USB
  - Wake from PS/2 devices
  - Power Management Event signal (PME#) wake-up support

1.13.1 ACPI

ACPI gives the operating system direct control over the power management and Plug and Play functions of a computer. The use of ACPI with these Desktop Boards requires an operating system that provides full ACPI support. ACPI features include:

- Plug and Play (including bus and device enumeration)
- Power management control of individual devices, add-in boards (some add-in boards may require an ACPI-aware driver), video displays, and hard disk drives
- Methods for achieving less than 15-watt system operation in the power-on/standby sleeping state
- A Soft-off feature that enables the operating system to power-off the computer
- Support for multiple wake-up events (see Table 12 on page 36)
- Support for a front panel power and sleep mode switch

Table 10 lists the system states based on how long the power switch is pressed, depending on how ACPI is configured with an ACPI-aware operating system.

Table 10. Effects of Pressing the Power Switch

If the system is in this state…	…and the power switch is pressed for	…the system enters this state
Off (ACPI G2/G5 – Soft off)	Less than four seconds	Power-on (ACPI G0 – working state)
On (ACPI G0 – working state)	Less than four seconds	Soft-off/Standby (ACPI G1 – sleeping state)
On (ACPI G0 – working state)	More than four seconds	Fail safe power-off (ACPI G2/G5 – Soft off)
Sleep (ACPI G1 – sleeping state)	Less than four seconds	Wake-up (ACPI G0 – working state)
Sleep (ACPI G1 – sleeping state)	More than four seconds	Power-off (ACPI G2/G5 – Soft off)

For information about	Refer to
The Desktop Boards' compliance level with ACPI	Section 1.4, page 13

1.13.1.1 System States and Power States

Under ACPI, the operating system directs all system and device power state transitions. The operating system puts devices in and out of low-power states based on user preferences and knowledge of how devices are being used by applications. Devices that are not being used can be turned off. The operating system uses information from applications and user settings to put the system as a whole into a low-power state.

Table 11 lists the power states supported by these Desktop Boards along with the associated system power targets. See the ACPI specification for a complete description of the various system and power states.

Table 11. Power States and Targeted System Power

Global States	Sleeping States	Processor States	Device States	Targeted System Power (Note 1)
G0 – working state	S0 – working	C0 – working	D0 – working state.	Full power > 30 W
G1 – sleeping state	S1 – Processor stopped	C1 – stop grant	D1, D2, D3 – device specification specific.	5 W < power < 52.5 W
G1 – sleeping state	S3 – Suspend to RAM. Context saved to RAM.	No power	D3 – no power except for wake-up logic.	Power < 5 W (Note 2)
G1 – sleeping state	S4 – Suspend to disk. Context saved to disk.	No power	D3 – no power except for wake-up logic.	Power < 5 W (Note 2)
G2/S5	S5 – Soft off. Context not saved. Cold boot is required.	No power	D3 – no power except for wake-up logic.	Power < 5 W (Note 2)
G3 – mechanical off AC power is disconnected from the computer.	No power to the system.	No power	D3 – no power for wake-up logic, except when provided by battery or external source.	No power to the system. Service can be performed safely.

Notes:

1. Total system power is dependent on the system configuration, including add-in boards and peripherals powered by the system chassis' power supply.
2. Dependent on the standby power consumption of wake-up devices used in the system.

1.13.1.2 Wake-up Devices and Events

Table 12 lists the devices or specific events that can wake the computer from specific states.

Table 12. Wake-up Devices and Events

These devices/events can wake up the computer…	…from this state
CNR	S1, S3, S4, S5
LAN	S1, S3, S4, S5 (Note)
Modem (back panel Serial port A)	S1, S3
PME# signal	S1, S3, S4, S5
Power switch	S1, S3, S4, S5
PS/2 devices	S1, S3
RTC alarm	S1, S3, S4, S5
USB	S1, S3

Note: For LAN and PME# signal, S5 is disabled by default in the BIOS Setup program. Setting this option to Power On will enable a wake-up event from LAN in the S5 state.

NOTE

The use of these wake-up events from an ACPI state requires an operating system that provides full ACPI support. In addition, software, drivers, and peripherals must fully support ACPI wake events.

1.13.2 Hardware Support

CAUTION

Ensure that the power supply provides adequate +5 V standby current if LAN wake capabilities and Instantly Available PC technology features are used. Failure to do so can damage the power supply.[17]

The Desktop Boards provide several power management hardware features, including:

- Power connector
- Fan connectors
- LAN wake capabilities
- Instantly Available PC technology
- Resume on Ring
- Wake from USB
- Wake from PS/2 keyboard
- PME# signal wake-up support

[17] Standby current requirements are product dependent. For information on power usage and standby current requirements, refer to the Product Supplement Document for your Intel Desktop Board.

LAN wake capabilities and Instantly Available PC technology require power from the +5 V standby line. The sections discussing these features describe the incremental standby power requirements for each.

Resume on Ring enables telephony devices to access the computer when it is in a power-managed state. The method used depends on the type of telephony device (external or internal).

NOTE

The use of Resume on Ring and Wake from USB technologies from an ACPI state requires an operating system that provides full ACPI support.

1.13.2.1 Power Connector

ATX12V- and SFX12V-compliant power supplies can turn off the system power through software control. When an ACPI-enabled system receives the correct command, the power supply removes all non-standby voltages.

When resuming from an AC power failure, the computer returns to the power state it was in before power was interrupted (on or off). The computer's response can be set using the Last Power State feature in the BIOS Setup program's Boot menu.

For information about	Refer to
The ATX specification	Section 1.4, page 13

1.13.2.2 Fan Connectors

Table 13 summarizes the function/operation of the fan connectors for boards with a hardware monitoring ASIC[18].

Table 13. Fan Connector Function/Operation for Desktop Boards with a Hardware Monitoring ASIC

Connector	Description
Processor fan	• +12 V DC connection for a processor fan or active fan heatsink. • Fan is on in the S0 or S1 state. Fan is off when the system is off or in the S3, S4, or S5 state. • Wired to a fan tachometer input of the I/O controller.
Front chassis fan	• +12 V DC connection for a system or chassis fan. • Fan is on in the S0 or S1 state. Fan is off when the system is off or in the S3, S4, or S5 state.
Rear chassis fan	• +12 V DC connection for a system or chassis fan. • Fan is on in the S0 or S1 state. Fan is off when the system is off or in the S3, S4, or S5 state. • Wired to a fan tachometer input of the I/O controller.

[18] Contact your Intel sales representative to determine which type of hardware monitoring ASIC is present on your Intel Desktop Board.

Table 14 summarizes the function/operation of the fan connectors for Desktop Boards with a hardware monitoring and fan control ASIC.

Table 14. Fan Connector Function/Operation for Desktop Boards with a Hardware Monitoring and Fan Control ASIC

Connector	Description
Processor fan	• +12 V DC connection for a processor fan or active fan heatsink. • Fan is on in the S0 or S1 state. Fan is off when the system is off or in the S3, S4, or S5 state. • Wired to a fan tachometer input of the hardware monitoring and fan control ASIC. • Closed-loop fan control that can adjust the fan speed or switch the fans on or off as needed.
Front chassis fan	• +12 V DC connection for a system or chassis fan. • Fan is on in the S0 or S1 state. Fan is off when the system is off or in the S3, S4, or S5 state. • Wired to a fan tachometer input of the hardware monitoring and fan control ASIC. • Closed-loop fan control that can adjust the fan speed or switch the fans on or off as needed.
Rear chassis fan	• +12 V DC connection for a system or chassis fan. • Fan is on in the S0 or S1 state. Fan is off when the system is off or in the S3, S4, or S5 state. • Wired to a fan tachometer input of the hardware monitoring and fan control ASIC. • Closed-loop fan control that can adjust the fan speed or switch the fans on or off as needed.

1.13.2.3 LAN Wake Capabilities

CAUTION

For LAN wake capabilities, the +5 V standby line for the power supply must be capable of providing adequate +5 V standby current. Failure to provide adequate standby current when implementing LAN wake capabilities can damage the power supply.[19]

LAN wake capabilities enable remote wake-up of the computer through a network. The LAN subsystem PCI bus network adapter monitors network traffic at the Media Independent Interface. Upon detecting a Magic Packet† frame, the LAN subsystem asserts a wake-up signal that powers up the computer. Depending on the LAN implementation, the Desktop Boards support LAN wake capabilities with ACPI in the following ways:

- The PCI bus PME# signal for PCI 2.2 compliant LAN designs
- The onboard LAN subsystem
- A CNR-based LAN subsystem

[19] Standby current requirements are product dependent. For information on power usage and standby current requirements, refer to the Product Supplement Document for your Intel Desktop Board.

1.13.2.4 Instantly Available PC Technology

CAUTION

For Instantly Available PC technology, the +5 V standby line for the power supply must be capable of providing adequate +5 V standby current. Failure to provide adequate standby current when implementing Instantly Available PC technology can damage the power supply.[20]

Instantly Available PC technology enables the Desktop Boards to enter the ACPI S3 (Suspend-to-RAM) sleep-state. While in the S3 sleep-state, the computer will appear to be off (the power supply is off and the front panel LED is amber if dual colored, or off if single colored.) When signaled by a wake-up device or event, the system quickly returns to its last known wake state. Table 12 on page 36 lists the devices and events that can wake the computer from the S3 state.

The Desktop Boards support the *PCI Bus Power Management Interface Specification*. For information on the version of this specification, see Section 1.4. Add-in boards that also support this specification can participate in power management and can be used to wake the computer.

The use of Instantly Available PC technology requires operating system support and PCI 2.2 compliant add-in cards and drivers.

1.13.2.5 +5 V Standby Power Indicator LED

The +5 V standby power indicator LED[21] shows that power is still present even when the computer appears to be off.

CAUTION

If AC power has been switched off and the standby power indicator is still lit, disconnect the power cord before installing or removing any devices connected to the board. Failure to do so could damage the board and any attached devices.

1.13.2.6 Resume on Ring

The operation of Resume on Ring can be summarized as follows:

- Resumes operation from ACPI S1 or S3 states
- Detects incoming call similarly for external and internal modems
- Requires modem interrupt be unmasked for correct operation

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[20] Standby current requirements are product dependent. For information on power usage and standby current requirements, refer to the Product Supplement Document for your Intel Desktop Board.

[21] The location of the standby power indicator LED is product dependent. For information, refer to the Product Supplement Document for your Desktop Board.

1.13.2.7 Wake from USB

USB bus activity wakes the computer from ACPI S1 or S3 states.

NOTE

Wake from USB requires the use of a USB peripheral that supports Wake from USB.

1.13.2.8 Wake from PS/2 Devices

PS/2 device activity wakes the computer from ACPI S1 or S3 states.

1.13.2.9 PME# Signal Wake-up Support

When the PME# signal on the PCI bus is asserted, the computer wakes from ACPI S1, S3, S4, or S5 states (with Wake on PME enabled in BIOS).

2 Technical Reference

2.1 Introduction

Sections 2.2 - 2.6 contain several standalone tables. Table 15 describes the system memory map, Table 16 shows the fixed I/O map, Table 17 lists the DMA channels, Table 18 defines the PCI configuration space map, and Table 19 describes the interrupts. The remaining sections in this chapter are introduced by text found with their respective section headings.

2.2 Memory Map

Table 15. System Memory Map

Address Range (decimal)	Address Range (hex)	Size	Description
1024 K - 2097152 K	100000 - 7FFFFFFF	2047 MB	Extended memory
960 K - 1024 K	F0000 - FFFFF	64 KB	Runtime BIOS
896 K - 960 K	E0000 - EFFFF	64 KB	Reserved
800 K - 896 K	C8000 - DFFFF	96 KB	Available high DOS memory (open to the PCI bus)
640 K - 800 K	A0000 - C7FFF	160 KB	Video memory and BIOS
639 K - 640 K	9FC00 - 9FFFF	1 KB	Extended BIOS data (movable by memory manager software)
512 K - 639 K	80000 - 9FBFF	127 KB	Extended conventional memory
0 K - 512 K	00000 - 7FFFF	512 KB	Conventional memory

2.3 Fixed I/O Map

Table 16. Fixed I/O Map

Address (hex)	Size	Description
0000 - 00FF	256 bytes	Used by the Desktop Board. Refer to the ICH4 data sheet for dynamic addressing information.
0170 - 0177	8 bytes	Secondary IDE channel
01F0 - 01F7	8 bytes	Primary IDE channel
0228 - 022F (Note 1)	8 bytes	LPT3
0278 - 027F (Note 1)	8 bytes	LPT2
02E8 - 02EF (Note 1)	8 bytes	COM4/video (8514A)
02F8 - 02FF (Note 1)	8 bytes	COM2
0376	1 byte	Secondary IDE channel command port
0378 - 037F	8 bytes	LPT1
03B0 - 03BB	12 bytes	Intel 82845G GMCH
03C0 - 03DF	32 bytes	Intel 82845G GMCH
03E8 - 03EF	8 bytes	COM3
03F0 - 03F5	6 bytes	Diskette channel 1
03F6	1 byte	Primary IDE channel command port
03F8 - 03FF	8 bytes	COM1
04D0 - 04D1	2 bytes	Edge/level triggered PIC
LPTn + 400	8 bytes	ECP port, LPTn base address + 400h
0CF8 - 0CFB (Note 2)	4 bytes	PCI configuration address register
0CF9 (Note 3)	1 byte	Turbo and reset control register
0CFC - 0CFF	4 bytes	PCI configuration data register
FFA0 - FFA7	8 bytes	Primary bus master IDE registers
FFA8 - FFAF	8 bytes	Secondary bus master IDE registers

Notes:

1. Default, but can be changed to another address range
2. Dword access only
3. Byte access only

NOTE

Some additional I/O addresses are not available due to ICH4 address aliassing. The ICH4 data sheet provides more information on address aliassing.

For information about	Refer to
Obtaining the ICH4 data sheet	Section 1.2 on page 12

2.4 DMA Channels

Table 17. DMA Channels

DMA Channel Number	Data Width	System Resource
0	8 or 16 bits	Open
1	8 or 16 bits	Parallel port
2	8 or 16 bits	Diskette drive
3	8 or 16 bits	Parallel port (for ECP or EPP)
4	8 or 16 bits	DMA controller
5	16 bits	Open
6	16 bits	Open
7	16 bits	Open

2.5 PCI Configuration Space Map

Table 18. PCI Configuration Space Map

Bus Number (hex)	Device Number (hex)	Function Number (hex)	Description
00	00	00	Memory controller of Intel 82845G component
00	01	00	Host to AGP bridge (virtual P2P)
00	02	00	Intel Extreme Graphics controller
00	1E	00	Hub link to PCI bridge
00	1F	00	Intel 82801DB ICH4 PCI to LPC bridge
00	1F	01	IDE controller
00	1F	03	SMBus controller
00	1F	05	AC ’97 audio controller
00	1F	06	AC ’97 modem controller (optional)
00	1D	00	USB UHCI controller 1
00	1D	01	USB UHCI controller 2
00	1D	02	USB UHCI controller 3
00	1D	07	EHCI controller
01	1D	00	AGP add-in card
(Note 1)	08	00	LAN controller (optional)
(Note 1)	00	00	PCI bus connector 1
(Note 1)	01	00	PCI bus connector 2
(Note 1)	02	00	PCI bus connector 3
(Note 1)	03	00	PCI bus connector 4 (Note 2)
(Note 1)	04	00	PCI bus connector 5 (Note 2)
(Note 1)	05	00	PCI bus connector 6 (Note 2)

Notes: 1. Bus number = 01 when the Intel Extreme Graphics controller is used. Bus number = 02 when an AGP add-in card is used.

2. For Desktop Boards with six PCI bus connectors.

2.6 Interrupts

The interrupts can be routed through either the Programmable Interrupt Controller (PIC) or the Advanced Programmable Interrupt Controller (APIC) portion of the ICH4 component. The PIC is supported in Windows 98 SE and Windows ME and uses the first 16 interrupts. The APIC is supported in Windows 2000 and Windows XP and supports a total of 24 interrupts.

Table 19. Interrupts

IRQ	System Resource
NMI	I/O channel check
0	Reserved, interval timer
1	Reserved, keyboard buffer full
2	Reserved, cascade interrupt from slave PIC
3	COM2 (Note 1)
4	COM1 (Note 1)
5	LPT2 (Plug and Play option)/User available
6	Diskette drive
7	LPT1 (Note 1)
8	Real-time clock
9	Reserved for ICH4 system management bus
10	User available
11	User available
12	Onboard mouse port (if present, else user available)
13	Reserved, math coprocessor
14	Primary IDE (if present, else user available)
15	Secondary IDE (if present, else user available)
16 (Note 2)	USB UHCI controller 1 (through PIRQA)
17 (Note 2)	AC ’97 audio/modem/User available (through PIRQB)
18 (Note 2)	ICH4 USB controller 3 (through PIRQC)
19 (Note 2)	ICH4 USB controller 2 (through PIRQD)
20 (Note 2)	ICH4 LAN (optional) (through PIRQE)
21 (Note 2)	User available (through PIRQF)
22 (Note 2)	User available (through PIRQG)
23 (Note 2)	ICH4 USB 2.0 EHCI controller/User available (through PIRQH)

Notes:

1. Default, but can be changed to another IRQ.
2. Available in APIC mode only.

2.7 PCI Interrupt Routing Map

This section describes interrupt sharing and how the interrupt signals are connected between the PCI bus connectors and onboard PCI devices. The PCI specification specifies how interrupts can be shared between devices attached to the PCI bus. In most cases, the small amount of latency added by interrupt sharing does not affect the operation or throughput of the devices. In some special cases where maximum performance is needed from a device, a PCI device should not share an interrupt with other PCI devices. Use the following information to avoid sharing an interrupt with a PCI add-in card.

PCI devices are categorized as follows to specify their interrupt grouping:

- INTA: By default, all add-in cards that require only one interrupt are in this category. For almost all cards that require more than one interrupt, the first interrupt on the card is also classified as INTA.
- INTB: Generally, the second interrupt on add-in cards that require two or more interrupts is classified as INTB. (This is not an absolute requirement.)
- INTC and INTD: Generally, a third interrupt on add-in cards is classified as INTC and a fourth interrupt is classified as INTD.

The ICH4 has eight Programmable Interrupt Request (PIRQ) input signals. All PCI interrupt sources either onboard or from a PCI add-in card connect to one of these PIRQ signals. Some PCI interrupt sources are electrically tied together on the Desktop Boards and therefore share the same interrupt. Table 20 shows an example of how the PIRQ signals are routed.

For example, using Table 20 as a reference, assume an add-in card using INTA is plugged into PCI bus connector 3. In PCI bus connector 3, INTA is connected to PIRQC, which is already connected to the ICH4 USB UHCI Controller 3. The add-in card in PCI bus connector 3 now shares an interrupt with this onboard interrupt source.

Table 20. PCI Interrupt Routing Map

PCI Interrupt Source	ICH4 PIRQ Signal Name							
	PIRQA	PIRQB	PIRQC	PIRQD	PIRQE	PIRQF	PIRQG	PIRQH
AGP connector	INTA	INTB						
ICH4 USB UHCI controller 1	INTA							
SMBus controller		INTB						
ICH4 USB UHCI controller 2				INTB				
AC '97 ICH4 Audio/Modem		INTB						
ICH4 LAN					INTA			
ICH4 USB UHCI controller 3			INTC					
ICH4 USB 2.0 EHCI controller								INTD
PCI bus connector 1					INTD	INTA	INTB	INTC
PCI bus connector 2					INTC	INTB	INTA	INTD
PCI bus connector 3	INTD	INTC	INTA	INTB				
PCI bus connector 4 (Note)			INTB	INTA		INTC	INTD	
PCI bus connector 5 (Note)	INTC	INTA			INTD			INTB
PCI bus connector 6 (Note)			INTA		INTB	INTD	INTC	

Note: For Desktop Boards with six PCI bus connectors.

NOTE

In PIC mode, the ICH4 can connect each PIRQ line internally to one of the IRQ signals (3, 4, 5, 6, 7, 9, 10, 11, 12, 14, and 15). Typically, a device that does not share a PIRQ line will have a unique interrupt. However, in certain interrupt-constrained situations, it is possible for two or more of the PIRQ lines to be connected to the same IRQ signal. Refer to Table 19 for the allocation of PIRQ lines to IRQ signals in APIC mode.

2.8 Environmental

Table 21 lists the environmental specifications for the Desktop Boards.

Table 21. Desktop Board Environmental Specifications

Parameter	Specification		
Temperature			
Non-Operating	-40 °C to +70 °C		
Operating	0 °C to +55 °C		
Shock			
Unpackaged	50 g trapezoidal waveform		
	Velocity change of 170 inches/second		
Packaged	Half sine 2 millisecond		
	Product Weight (pounds)	Free Fall (inches)	Velocity Change (inches/sec)
	<20	36	167
	21-40	30	152
	41-80	24	136
	81-100	18	118
Vibration			
Unpackaged	5 Hz to 20 Hz: 0.01 g^2 Hz sloping up to 0.02 g^2 Hz		
	20 Hz to 500 Hz: 0.02 g^2 Hz (flat)		
Packaged	10 Hz to 40 Hz: 0.015 g^2 Hz (flat)		
	40 Hz to 500 Hz: 0.015 g^2 Hz sloping down to 0.00015 g^2 Hz		

3 BIOS Overview

3.1 Introduction

The Desktop Boards use an Intel/AMI BIOS[22] that is stored in the Firmware Hub (FWH) and can be updated using a disk-based program. The FWH contains the BIOS Setup program, POST, the PCI auto-configuration utility, and Plug and Play support.

The BIOS displays a message during POST identifying the type of BIOS and a revision code. The initial production BIOSs are identified as RG84510.86A.

When the Desktop Board's jumper is set to configuration mode and the computer is powered-up, the BIOS compares the CPU version and the microcode version in the BIOS and reports if the two match.

For information about	Refer to
The Desktop Boards' compliance level with Plug and Play	Section 1.4, page 13

3.2 BIOS Flash Memory Organization

The Firmware Hub (FWH) includes a 4 Mbit (512 KB) symmetrical flash memory device. Internally, the device is grouped into eight 64-KB blocks that are individually erasable, lockable, and unlockable.

3.3 Resource Configuration

3.3.1 PCI Autoconfiguration

The BIOS can automatically configure PCI devices. PCI devices may be onboard or add-in cards. Autoconfiguration lets a user insert or remove PCI cards without having to configure the system. When a user turns on the system after adding a PCI card, the BIOS automatically configures interrupts, the I/O space, and other system resources. Any interrupts set to Available in Setup are considered to be available for use by the add-in card. Autoconfiguration information is stored in ESCD format.

For information about the versions of PCI and Plug and Play supported by the BIOS, see Section 1.4.

[22] Some Desktop Boards may use a different BIOS core. For more information, refer to the Product Supplement Document for your Desktop Board.

3.3.2 PCI IDE Support

If you select Auto in the BIOS Setup program, the BIOS automatically sets up the two PCI IDE connectors with independent I/O channel support. The IDE interface supports hard drives up to ATA-66/100 and recognizes any ATAPI compliant devices, including CD-ROM drives, tape drives, and Ultra DMA drives (see Section 1.4 for the supported version of ATAPI). The BIOS determines the capabilities of each drive and configures them to optimize capacity and performance. To take advantage of the high capacities typically available today, hard drives are automatically configured for Logical Block Addressing (LBA) and to PIO Mode 3 or 4, depending on the capability of the drive. You can override the auto-configuration options by specifying manual configuration in the BIOS Setup program.

To use ATA-66/100 features the following items are required:

- An ATA-66/100 peripheral device
- An ATA-66/100 compatible cable
- ATA-66/100 operating system device drivers

NOTE

ATA-66/100 compatible cables are backward compatible with drives using slower IDE transfer protocols. If an ATA-66/100 disk drive and a disk drive using any other IDE transfer protocol are attached to the same cable, the maximum transfer rate between the drives is reduced to that of the slowest device.

NOTE

Do not connect an ATA device as a slave on the same IDE cable as an ATAPI master device. For example, do not connect an ATA hard drive as a slave to an ATAPI CD-ROM drive.

3.4 System Management BIOS (SMBIOS)

SMBIOS is a Desktop Management Interface (DMI) compliant method for managing computers in a managed network.

The main component of SMBIOS is the Management Information Format (MIF) database, which contains information about the computing system and its components. Using SMBIOS, a system administrator can obtain the system types, capabilities, operational status, and installation dates for system components. The MIF database defines the data and provides the method for accessing this information. The BIOS enables applications such as third-party management software to use SMBIOS. The BIOS stores and reports the following SMBIOS information:

- BIOS data, such as the BIOS revision level
- Fixed-system data, such as peripherals, serial numbers, and asset tags
- Resource data, such as memory size, cache size, and processor speed
- Dynamic data, such as event detection and error logging

Non-Plug and Play operating systems, such as Windows NT, require an additional interface for obtaining the SMBIOS information. The BIOS supports an SMBIOS table interface for such operating systems. Using this support, an SMBIOS service-level application running on a non-Plug and Play operating system can obtain the SMBIOS information.

For information about	Refer to
The Desktop Boards' compliance level with SMBIOS	Section 1.4, page 13

3.5 Legacy USB Support

Legacy USB support enables USB devices such as keyboards, mice, and hubs to be used even when the operating system's USB drivers are not yet available. Legacy USB support is used to access the BIOS Setup program, and to install an operating system that supports USB. By default, Legacy USB support is set to Enabled.

Legacy USB support operates as follows:

1. When you apply power to the computer, legacy support is disabled.
2. POST begins.
3. Legacy USB support is enabled by the BIOS allowing you to use a USB keyboard to enter and configure the BIOS Setup program and the maintenance menu.
4. POST completes.
5. The operating system loads. While the operating system is loading, USB keyboards and mice are recognized and may be used to configure the operating system. (Keyboards and mice are not recognized during this period if Legacy USB support was set to Disabled in the BIOS Setup program.)
6. After the operating system loads the USB drivers, all legacy and non-legacy USB devices are recognized by the operating system, and Legacy USB support from the BIOS is no longer used.

To install an operating system that supports USB, verify that Legacy USB support in the BIOS Setup program is set to Enabled and follow the operating system's installation instructions.

NOTE

Legacy USB support is for keyboards, mice, and hubs only. Other USB devices are not supported in legacy mode.

3.6 BIOS Updates

The BIOS can be updated using either of the following utilities, which are available on the Intel World Wide Web site:

- Intel® Express BIOS Update utility, which enables automated updating while in the Windows environment. Using this utility, the BIOS can be updated from a file on a hard disk, a 1.44 MB diskette, or a CD-ROM, or from the file location on the Web.
- Intel® Flash Memory Update Utility, which requires creation of a boot diskette and manual rebooting of the system. Using this utility, the BIOS can be updated from a file on a 1.44 MB diskette (from a legacy diskette drive or an LS-120 diskette drive) or a CD-ROM.

Both utilities support the following BIOS maintenance functions:

- Verifying that the updated BIOS matches the target system to prevent accidentally installing an incompatible BIOS.
- Updating both the BIOS boot block and the main BIOS. This process is fault tolerant to prevent boot block corruption.
- Updating the BIOS boot block separately.
- Changing the language section of the BIOS.
- Updating replaceable BIOS modules, such as the video BIOS module.
- Inserting a custom splash screen.

NOTE

Review the instructions distributed with the upgrade utility before attempting a BIOS update.

For information about	Refer to
The Intel World Wide Web site	Section 1.2, page 12

3.6.1 Language Support

The BIOS Setup program and help messages are supported in five languages: US English, German, Italian, French, and Spanish. The default language is US English, which is present unless another language is selected in the BIOS Setup program.

3.6.2 Custom Splash Screen

During POST, an Intel splash screen is displayed by default. This splash screen can be replaced with a custom splash screen. A utility is available from Intel to assist with creating a custom splash screen. The custom splash screen can be programmed into the flash memory using the BIOS upgrade utility. Information about this capability is available on the Intel Support World Wide Web site.

For information about	Refer to
The Intel World Wide Web site	Section 1.2, page 12

3.7 Recovering BIOS Data

Some types of failure can destroy the BIOS. For example, the data can be lost if a power outage occurs while the BIOS is being updated in flash memory. The BIOS can be recovered from a diskette using the BIOS recovery mode. When recovering the BIOS, be aware of the following:

- Because of the small amount of code available in the non-erasable boot block area, there is no video support. You can only monitor this procedure by listening to the speaker or looking at the diskette drive LED.
- The recovery process may take several minutes; larger BIOS flash memory devices require more time.
- Two beeps and the end of activity in the diskette drive indicate successful BIOS recovery.
- A series of continuous beeps indicates a failed BIOS recovery.

To create a BIOS recovery diskette, a bootable diskette must be created and the BIOS update files copied to it. BIOS upgrades and the Intel Flash Memory Update Utility are available from Intel Customer Support through the Intel World Wide Web site.

NOTE

Even if the computer is configured to boot from an LS-120 diskette (in the Setup program's Removable Devices submenu), the BIOS recovery diskette must be a standard 1.44 MB diskette not a 120 MB diskette.

For information about	Refer to
The Boot menu in the BIOS Setup program	Section 4.7, page 77
Contacting Intel customer support	Section 1.2, page 12

3.8 Boot Options

In the BIOS Setup program, the user can choose to boot from a diskette drive, hard drives, CD-ROM, or the network. The default setting is for the diskette drive to be the first boot device, the hard drive second, and the ATAPI CD-ROM third. The fourth device is disabled.

3.8.1 CD-ROM Boot

Booting from CD-ROM is supported in compliance to the El Torito bootable CD-ROM format specification. Under the Boot menu in the BIOS Setup program, ATAPI CD-ROM is listed as a boot device. Boot devices are defined in priority order. Accordingly, if there is not a bootable CD in the CD-ROM drive, the system will attempt to boot from the next defined drive.

For information about	Refer to
The El Torito specification	Section 1.4, page 13

3.8.2 Network Boot

The network can be selected as a boot device. This selection allows booting from the onboard LAN or a network add-in card with a remote boot ROM installed.

Pressing the <F12> key during POST automatically forces boot from the LAN.

3.8.3 Booting Without Attached Devices

For use in embedded applications, the BIOS has been designed so that after passing the POST, the operating system loader is invoked even if the following devices are not present:

- Video adapter
- Keyboard
- Mouse

3.8.4 Changing the Default Boot Device During POST

Pressing the <F10> key during POST causes a boot device menu to be displayed. This menu displays the list of available boot devices (as set in the BIOS setup program's Boot Device Priority Submenu). Table 22 lists the boot device menu options.

Table 22. Boot Device Menu Options

Boot Device Menu Function Keys	Description
<↑> or <↓>	Selects a default boot device
<Enter>	Exits the menu, saves changes, and boots from the selected device
<Esc>	Exits the menu without saving changes

3.9 Fast Booting Systems with Intel® Rapid BIOS Boot

These factors affect system boot speed:

- Selecting and configuring peripherals properly
- Using an optimized BIOS, such as the Intel Rapid® BIOS

3.9.1 Peripheral Selection and Configuration

The following techniques help improve system boot speed:

- Choose a hard drive with parameters such as "power-up to data ready" less than eight seconds, that minimize hard drive startup delays.
- Select a CD-ROM drive with a fast initialization rate. This rate can influence POST execution time.
- Eliminate unnecessary add-in adapter features, such as logo displays, screen repaints, or mode changes in POST. These features may add time to the boot process.
- Try different monitors. Some monitors initialize and communicate with the BIOS more quickly, which enables the system to boot more quickly.

3.9.2 Intel Rapid BIOS Boot

Use of the following BIOS Setup program settings reduces the POST execution time.

In the Boot Menu:

- Set the hard disk drive as the first boot device. As a result, the POST does not first seek a diskette drive, which saves about one second from the POST execution time.
- Disable Quiet Boot, which eliminates display of the logo splash screen. This could save several seconds of painting complex graphic images and changing video modes.
- Enabled Intel Rapid BIOS Boot. This feature bypasses memory count and the search for a diskette drive.

In the Peripheral Configuration submenu, disable the LAN device if it will not be used. This can reduce up to four seconds of option ROM boot time.

NOTE

It is possible to optimize the boot process to the point where the system boots so quickly that the Intel logo screen (or a custom logo splash screen) will not be seen. Monitors and hard disk drives with minimum initialization times can also contribute to a boot time that might be so fast that necessary logo screens and POST messages cannot be seen.

This boot time may be so fast that some drives might be not be initialized at all. If this condition should occur, it is possible to introduce a programmable delay ranging from three to 30 seconds (using the Hard Disk Pre-Delay feature of the Advanced Menu in the IDE Configuration Submenu of the BIOS Setup program).

For information about	Refer to
IDE Configuration Submenu in the BIOS Setup program	Section 4.4.4, page 66

3.10 BIOS Security Features

The BIOS includes security features that restrict access to the BIOS Setup program and who can boot the computer. A supervisor password and a user password can be set for the BIOS Setup program and for booting the computer, with the following restrictions:

- The supervisor password gives unrestricted access to view and change all the Setup options in the BIOS Setup program. This is the supervisor mode.
- The user password gives access to view and change Setup options in the BIOS Setup program based on the setting of the User Access Level option in the BIOS Setup Program's Security Menu. This is the user mode.
- If only the supervisor password is set, pressing the <Enter> key at the password prompt of the BIOS Setup program allows the user access to Setup based on the setting of the User Access Level option in the BIOS Setup Program's Security Menu.
- If both the supervisor and user passwords are set, users can enter either the supervisor password or the user password to access Setup. Users have access to Setup respective to which password is entered.

- Setting the user password restricts who can boot the computer. The password prompt will be displayed before the computer is booted. If only the supervisor password is set, the computer boots without asking for a password. If both passwords are set, the user can enter either password to boot the computer.

Table 23 shows the effects of setting the supervisor password and user password. This table is for reference only and is not displayed on the screen.

Table 23. Supervisor and User Password Functions

Password Set	Supervisor Mode	User Mode	Setup Options	Password to Enter Setup	Password During Boot
Neither	Can change all options (Note)	Can change all options (Note)	None	None	None
Supervisor only	Can change all options	Can change a limited number of options	Supervisor Password	Supervisor	None
User only	N/A	Can change all options	Enter Password Clear User Password	User	User
Supervisor and user set	Can change all options	Can change a limited number of options	Supervisor Password Enter Password	Supervisor or user	Supervisor or user

Note: If no password is set, any user can change all Setup options.

For information about	Refer to
Setting user and supervisor passwords	Section 4.5, page 75

INTEGRATOR'S NOTE

For enhanced security, use different passwords for the supervisor and user passwords.

4 BIOS Setup Program

4.1 Introduction

The BIOS Setup program can be used to view and change the BIOS settings for the computer. The BIOS Setup program is accessed by pressing the <F2> key after the Power-On Self-Test (POST) memory test begins and before the operating system boot begins. The menu bar is shown below.

Maintenance	Main	Advanced	Security	Power	Boot	Exit

Table 24 lists the BIOS Setup program menu features.

Table 24. BIOS Setup Program Menu Bar

Maintenance	Main	Advanced	Security	Power	Boot	Exit
Clears passwords and BIS credentials and enables extended configuration mode	Allocates resources for hardware components	Configures advanced features available through the chipset	Sets passwords and security features	Configures power management features	Selects boot options and power supply controls	Saves or discards changes to Setup program options

For information about	Refer to
Boot Integrity Services (BIS)	Section 1.4, page 13

NOTE

In this chapter, all examples of the BIOS Setup program menu bar include the maintenance menu; however, the maintenance menu is displayed only when the Desktop Board is in configuration mode.

Table 25 lists the function keys available for menu screens.

Table 25. BIOS Setup Program Function Keys

BIOS Setup Program Function Key	Description
<←> or <→>	Selects a different menu screen (Moves the cursor left or right)
<↑> or <↓>	Selects an item (Moves the cursor up or down)
<Tab>	Selects a field (Not implemented)
<Enter>	Executes command or selects the submenu
<F9>	Load the default configuration values for the current menu
<F10>	Save the current values and exits the BIOS Setup program
<Esc>	Exits the menu

4.2 Maintenance Menu

To access this menu, select Maintenance on the menu bar at the top of the screen.

Maintenance	Main	Advanced	Security	Power	Boot	Exit

The menu shown in Table 26 is for clearing Setup passwords and enabling extended configuration mode. Setup only displays this menu in configuration mode.

Table 26. Maintenance Menu

Feature	Options	Description
Clear All Passwords	• **Ok (default)** • Cancel	Clears the user and supervisor passwords.
Clear BIS Credentials	• **Ok (default)** • Cancel	Clears the Wired for Management Boot Integrity Service (BIS) credentials.
CPU Stepping Signature	No options	Displays CPU's Stepping Signature.
CPU Microcode Update Revision	No options	Displays CPU's Microcode Update Revision.

4.3 Main Menu

To access this menu, select Main on the menu bar at the top of the screen.

Maintenance	**Main**	Advanced	Security	Power	Boot	Exit

Table 27 describes the Main menu. This menu reports processor and memory information and is for configuring the system date and system time.

Table 27. Main Menu

Feature	Options	Description
BIOS Version	No options	Displays the version of the BIOS.
Processor Type	No options	Displays processor type.
Processor Speed	No options	Displays processor speed.
System Bus Speed	No options	Displays the system bus speed.
System Memory Speed	No options	Displays the system memory speed.
Cache RAM	No options	Displays the size of second-level cache.
Total Memory	No options	Displays the total amount of RAM.
Memory Bank 0 Memory Bank 1	No options	Displays the amount and type of RAM in the memory banks.
Language	• **English (default)** • Español	Selects the current default language used by the BIOS.
System Time	Hour, minute, and second	Specifies the current time.
System Date	Day of week Month/day/year	Specifies the current date.

4.4 Advanced Menu

To access this menu, select Advanced on the menu bar at the top of the screen.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

Table 28 describes the Advanced Menu. This menu is used for setting advanced features that are available through the chipset.

Table 28. Advanced Menu

Feature	Options	Description
PCI Configuration	Select to display submenu	Configures individual PCI slot's IRQ priority.
Boot Configuration	Select to display submenu	Configures Plug and Play and the Numlock key, and resets configuration data.
Peripheral Configuration	Select to display submenu	Configures peripheral ports and devices.
IDE Configuration	Select to display submenu	Specifies type of connected IDE devices.
Diskette Configuration	Select to display submenu	Configures the diskette drive.
Event Log Configuration	Select to display submenu	Configures Event Logging.
Video Configuration	Select to display submenu	Configures video features.
USB Configuration	Select to display submenu	Configures USB support.
Chipset Configuration	Select to display submenu	Configures advanced chipset features.

4.4.1 PCI Configuration Submenu

To access this submenu, select Advanced on the menu bar and then PCI Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu shown in Table 29 is used to configure the IRQ priority of PCI slots individually.

Table 29. PCI Configuration Submenu

Feature	Options	Description
PCI Slot1 IRQ Priority (Note 1)	• **Auto (default)** • 5 • 9 • 10 • 11	Allows selection of IRQ priority for PCI bus connector 1.
PCI Slot2 IRQ Priority (Note 1)	• **Auto (default)** • 5 • 9 • 10 • 11	Allows selection of IRQ priority for PCI bus connector 2.
PCI Slot3 IRQ Priority (Note 1)	• **Auto (default)** • 5 • 9 • 10 • 11	Allows selection of IRQ priority for PCI bus connector 3.
PCI Slot4 IRQ Priority (Note 1, Note 2)	• **Auto (default)** • 5 • 9 • 10 • 11	Allows selection of IRQ priority for PCI bus connector 4.

continued

Table 29. PCI Configuration Submenu (continued)

Feature	Options	Description
PCI Slot5 IRQ Priority (Note 1, Note 2)	• **Auto (default)** • 5 • 9 • 10 • 11	Allows selection of IRQ priority for PCI bus connector 5.
PCI Slot6 IRQ Priority (Note 1, Note 2)	• **Auto (default)** • 5 • 9 • 10 • 11	Allows selection of IRQ priority for PCI bus connector 6.

Notes:

1. Additional interrupts may be available if certain onboard devices (such as the serial and parallel ports) are disabled.
2. Not present on Desktop Boards with only three PCI bus connectors.

4.4.2 Boot Configuration Submenu

To access this submenu, select Advanced on the menu bar and then Boot Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu represented by Table 30 is for setting Plug and Play options, resetting configuration data, and the power-on state of the Numlock key.

Table 30. Boot Configuration Submenu

Feature	Options	Description
Plug & Play O/S	• **No (default)** • Yes	Specifies if manual configuration is desired. *No* lets the BIOS configure all devices. This setting is appropriate when using a Plug and Play operating system. *Yes* lets the operating system configure Plug and Play devices not required to boot the system. This option is available for use during lab testing.
Numlock	• Off • **On (default)**	Specifies the power-on state of the Numlock feature on the numeric keypad of the keyboard.

4.4.3 Peripheral Configuration Submenu

To access this submenu, select Advanced on the menu bar and then Peripheral Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu represented in Table 31 is used for configuring computer peripherals.

Table 31. Peripheral Configuration Submenu

Feature	Options	Description
Serial Port A	• Disabled • Enabled • **Auto (default)**	Configures serial port A. *Auto* assigns the first free COM port, normally COM1, the address 3F8h, and the interrupt IRQ4. An * (asterisk) displayed next to an address indicates a conflict with another device.
Base I/O address (This feature is present only when Serial Port A is set to *Enabled*)	• **3F8 (default)** • 2F8 • 3E8 • 2E8	Specifies the base I/O address for serial port A, if serial port A is Enabled.
Interrupt (This feature is present only when Serial Port A is set to *Enabled*)	• IRQ 3 • **IRQ 4 (default)**	Specifies the interrupt for serial port A, if serial port A is Enabled.
Parallel port	• Disabled • Enabled • **Auto (default)**	Configures the parallel port. *Auto* assigns LPT1 the address 378h and the interrupt IRQ7. An * (asterisk) displayed next to an address indicates a conflict with another device.
Mode	• Output Only • **Bi-directional (default)** • EPP • ECP	Selects the mode for the parallel port. Not available if the parallel port is disabled. *Output Only* operates in AT†-compatible mode. *Bi-directional* operates in PS/2-compatible mode. *EPP* is Extended Parallel Port mode, a high-speed bi-directional mode. *ECP* is Enhanced Capabilities Port mode, a high-speed bi-directional mode.

Continued

Table 31. Peripheral Configuration Submenu (continued)

Feature	Options	Description
Base I/O address (This feature is present only when Parallel Port is set to *Enabled*)	• **378 (default)** • 278	Specifies the base I/O address for the parallel port.
Interrupt (This feature is present only when Parallel Port is set to *Enabled*)	• IRQ 5 • **IRQ 7 (default)**	Specifies the interrupt for the parallel port.
DMA (This feature is present only when Parallel Port Mode is set to *ECP*)	• 1 • **3 (default)**	Specifies the DMA channel.
Audio	• **Enabled (default)** • Disabled	Enables or disables the onboard audio subsystem. For boards with no onboard audio subsystem, this option does not appear.
LAN Device	• Disabled • **Enabled (default)**	Enables or disables the onboard LAN device. For boards with no onboard LAN subsystem, this option will not appear.

4.4.4 IDE Configuration Submenu

To access this submenu, select Advanced on the menu bar and then IDE Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The menu represented in Table 32 is used to configure IDE device options.

Table 32. IDE Configuration Submenu

Feature	Options	Description
IDE Controller	• Disabled • Primary • Secondary • **Both (default)**	Specifies the integrated IDE controller. *Primary* enables only the primary IDE controller. *Secondary* enables only the secondary IDE controller. *Both* enables both IDE controllers.
PCI IDE Bus Master	• Disabled • **Enabled (default)**	Enables/disables the use of DMA for hard drive BIOS INT13 reads and writes.
Hard Disk Pre-Delay	• **Disabled (default)** • 3 Seconds • 6 Seconds • 9 Seconds • 12 Seconds • 15 Seconds • 21 Seconds • 30 Seconds	Specifies the hard disk drive pre-delay.
Primary IDE Master	Select to display sub-menu	Reports type of connected IDE device.
Primary IDE Slave	Select to display sub-menu	Reports type of connected IDE device.
Secondary IDE Master	Select to display sub-menu	Reports type of connected IDE device.
Secondary IDE Slave	Select to display sub-menu	Reports type of connected IDE device.

4.4.4.1 Primary/Secondary IDE Master/Slave Submenus

To access these submenus, select Advanced on the menu bar, then IDE Configuration, and then the master or slave to be configured.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration **Primary IDE Master** **Primary IDE Slave** **Secondary IDE Master** **Secondary IDE Slave**
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

There are four IDE submenus: primary master, primary slave, secondary master, and secondary slave. Table 33 shows the format of the IDE submenus. For brevity, only one example is shown.

Table 33. Primary/Secondary IDE Master/Slave Submenus

Feature	Options	Description
Drive Installed	No options	Displays the type of drive installed.
Type	• **Auto (default)** • User	Specifies the IDE configuration mode for IDE devices. *User* allows capabilities to be changed. *Auto* fills-in capabilities from ATA/ATAPI device.
Maximum Capacity	No options	Displays the capacity of the drive.
LBA/Large Mode	• Disabled • **Auto (default)**	Selects the translation mode for the IDE hard disk.
Block Mode	• Disabled • **Auto (default)**	Disabled = Data transfers to/from the device occur one sector at a time. Auto = Data transfers to/from the device occur multiple sectors at a time if the device supports block mode transfers.

continued

Table 33. Primary/Secondary IDE Master/Slave Submenus (continued)

Feature	Options	Description
PIO Mode	• **Auto (default)** • 0 • 1 • 2 • 3 • 4	Specifies the PIO mode.
DMA Mode	• **Auto (default)** • SWDMA0 • SWDMA1 • SWDMA2 • MWDMA0 • MWDMA1 • MWDMA2 • UDMA0 • UDMA1 • UDMA2 • UDMA3 • UDMA4 • UDMA5	Specifies the DMA mode for the drive. *Auto* = Auto-detected *SWDMAn* = Single Word DMA*n* *SWDMAn* = Multi Word DMA*n* *UDMAn* = Ultra DMA*n*
Cable Detected	No options	Displays the type of cable connected to the IDE interface: 40-conductor or 80-conductor (for ATA-100 peripherals).

Note: If an LS-120 drive is attached to the system, a row entitled ARMD Emulation Type will be displayed in the above table. The BIOS will always recognize the drive as an ATAPI floppy drive. The ARMD Emulation Type should always be set to Floppy.

4.4.5 Diskette Configuration Submenu

To access this menu, select Advanced on the menu bar and then Diskette Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu represented by Table 34 is used for configuring the diskette drive.

Table 34. Diskette Configuration Submenu

Feature	Options	Description
Diskette Controller	• Disabled • **Enabled (default)**	Disables or enables the integrated diskette controller.
Floppy A	• Not Installed • 360 KB 5¼" • 1.2 MB 5¼" • 720 KB 3½" • **1.44/1.25 MB 3½" (default)** • 2.88 MB 3½"	Specifies the capacity and physical size of diskette drive A.
Diskette Write Protect	• **Disabled (default)** • Enabled	Disables or enables write protection for the diskette drive.

4.4.6 Event Log Configuration Submenu

To access this menu, select Advanced on the menu bar and then Event Log Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu represented by Table 35 is used to configure the event logging features.

Table 35. Event Log Configuration Submenu

Feature	Options	Description
Event Log	No options	Indicates if there is space available in the event log.
View Event Log	[Enter]	Displays the event log.
Clear Event Log	• **Ok (default)** • Cancel	Clears the event log after rebooting.
Event Logging	• Disabled • **Enabled (default)**	Enables logging of events.
Mark Events As Read	• **Ok (default)** • Cancel	Marks all events as read.

4.4.7 Video Configuration Submenu

To access this menu, select Advanced on the menu bar and then Video Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu represented in Table 36 is for configuring the video features.

Table 36. Video Configuration Submenu

Feature	Options	Description
AGP Aperture Size	• 4 MB • 8 MB • 16 MB • 32 MB • **64 MB (default)** • 128 MB • 256 MB	Sets the aperture size for the video controller.
Primary Video Adapter	• **AGP (default)** • PCI	Selects primary video adapter to be used during boot.
Frame Buffer Size	• 512 KB • **1 MB (default)** • 8 MB	Sets the frame buffer size.

4.4.8 USB Configuration Submenu

To access this menu, select Advanced on the menu bar and then USB Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit
		PCI Configuration				
		Boot Configuration				
		Peripheral Configuration				
		IDE Configuration				
		Diskette Configuration				
		Event Log Configuration				
		Video Configuration				
		USB Configuration				
		Chipset Configuration				

The submenu represented in Table 37 is for configuring the USB features.

Table 37. USB Configuration Submenu

Feature	Options	Description
High Speed USB	• Disabled • **Enabled (default)**	Set to *Disabled* when a USB 2.0 driver is not available.
Legacy USB Support	• Disabled • **Enabled (default)**	Enables/disables legacy USB support.

4.4.9 Chipset Configuration Submenu

To access this menu, select Advanced on the menu bar and then Chipset Configuration.

Maintenance	Main	**Advanced**	Security	Power	Boot	Exit

PCI Configuration
Boot Configuration
Peripheral Configuration
IDE Configuration
Diskette Configuration
Event Log Configuration
Video Configuration
USB Configuration
Chipset Configuration

The submenu represented in Table 38 is for configuring chipset options.

Table 38. Chipset Configuration Submenu

Feature	Options	Description
ISA Enable Bit	• **Disabled (default)** • Enabled	When set to *Enable*, a PCI-to-PCI bridge will only recognize I/O addresses that do not alias to an ISA range (within the bridge's assigned I/O range).
PCI Latency Timer	• **32 (default)** • 64 • 96 • 128 • 160 • 192 • 224 • 248	Allows you to control the time (in PCI bus clock cycles) that an agent on the PC bus can hold the bus when another agent has requested the bus.
Extended Configuration	• **Default (default)** • User Defined	Allows the setting of extended configuration options.
SDRAM Frequency (For Desktop Boards with DDR SDRAM)	• **Auto (default)** • 200 MHz • 266 MHz	Allows override of detected memory frequency value. **NOTE:** If SDRAM Frequency is changed, you must reboot for the change to take effect. After changing this setting and rebooting, the System Memory Speed parameter in the Main menu will reflect the new value.
SDRAM Frequency (For Desktop Boards with SDR SDRAM)	No options	Displays the system memory speed (133 MHz).

continued

Table 38. Chipset Configuration Submenu (continued)

Feature	Options	Description
SDRAM Timing Control	• **Auto (default)** • Manual – Aggressive • Manual – User Defined	*Auto* = Timings will be programmed according to the memory detected. *Manual – Aggressive* = Selects most aggressive user-defined timings. *Manual – User Defined* = Allows manual override of detected SDRAM settings.
SDRAM RAS# Active to Precharge	• 7 • 6 • **5 (default)**	Corresponds to tRAS.
SDRAM CAS# Latency	• **2.0 (default)** • 2.5	Selects the number of clock cycles required to address a column in memory.
SDRAM RAS# to CAS# Delay	• 3 • **2 (default)**	Selects the number of clock cycles between addressing a row and addressing a column.
SDRAM RAS# Precharge	• 3 • **2 (default)**	Selects the length of time required before accessing a new row.

4.5 Security Menu

To access this menu, select Security from the menu bar at the top of the screen.

Maintenance	Main	Advanced	**Security**	Power	Boot	Exit

The menu represented by Table 39 is for setting passwords and security features.

Table 39. Security Menu

Feature	Options	Description
Supervisor Password	No options	Reports if there is a supervisor password set.
User Password	No options	Reports if there is a user password set.
Set Supervisor Password	Password can be up to seven alphanumeric characters.	Specifies the supervisor password.
User Access Level (Note 1)	• No Access • View Only • Limited • **Full (default)**	Sets BIOS Setup Utility access rights for user level.
Set User Password	Password can be up to seven alphanumeric characters.	Specifies the user password.
Clear User Password (Note 2)	• **Ok (default)** • Cancel	Clears the user password.

Notes:

1. This feature appears only if a supervisor password has been set.
2. This feature appears only if a user password has been set.

4.6 Power Menu

To access this menu, select Power from the menu bar at the top of the screen.

Maintenance	Main	Advanced	Security	**Power**	Boot	Exit
				ACPI		

The menu represented in Table 40 is for setting the power management features.

Table 40. Power Menu

Feature	Options	Description
ACPI	Select to display submenu	Sets the ACPI power management options.
After Power Failure	• Stay Off • **Last State (default)** • Power On	Specifies the mode of operation if an AC power loss occurs. *Stay Off* keeps the power off until the power button is pressed. *Last State* restores the previous power state before power loss occurred. *Power On* restores power to the computer.
Wake on PCI PME	• **Stay Off (default)** • Power On	Specifies how the computer responds to a PCI power management event.
Wake on Modem Ring	• **Stay Off (default)** • Power On	Specifies how the computer responds to an incoming call on an installed modem when the power is off.

4.6.1 ACPI Submenu

To access this menu, select Power from the menu bar at the top of the screen and then ACPI.

Maintenance	Main	Advanced	Security	**Power**	Boot	Exit
				ACPI		

The submenu represented in Table 41 is for setting the ACPI power options.

Table 41. ACPI Submenu

Feature	Options	Description
ACPI Suspend State	• S1 State • **S3 State (default)**	S1 is the safest mode but consumes more power. S3 consumes less power, but some drivers may not support this state.
Wake on LAN from S5	• **Stay Off (default)** • Power On	In ACPI soft-off mode only, determines how the system responds to a LAN wake-up event.

4.7 Boot Menu

To access this menu, select Boot from the menu bar at the top of the screen.

Maintenance	Main	Advanced	Security	Power	**Boot**	Exit

Boot Device Priority
Hard Disk Drives
Removable Devices
ATAPI CD-ROM Drives

The menu represented in Table 42 is used to set the boot features and the boot sequence.

Table 42. Boot Menu

Feature	Options	Description
Silent Boot	• Disabled • **Enabled (default)**	*Disabled* displays normal POST messages. *Enabled* displays OEM graphic instead of POST messages.
Intel Rapid BIOS Boot	• Disabled • **Enabled (default)**	Enables the computer to boot without running certain POST tests.
Scan User Flash Area	• Disabled • **Enabled (default)**	Enables the BIOS to scan the flash memory for user binary files that are executed at boot time.
PXE Boot to LAN	• **Disabled (default)** • Enabled	Disables/enables PXE boot to LAN. Note: When set to *Enabled*, you must reboot for the Intel Boot Agent device to be available in the Boot Device menu.
USB Boot	• Disabled • **Enabled (default)**	Disables/enables booting to USB boot devices.
Boot Device Priority	Select to display submenu	Specifies the boot sequence from the available types of boot devices.
Hard Disk Drives	Select to display submenu	Specifies the boot sequence from the available hard disk drives.
Removable Devices	Select to display submenu	Specifies the boot sequence from the available removable devices.
ATAPI CD-ROM Drives	Select to display submenu	Specifies the boot sequence from the available ATAPI CD-ROM drives.

4.7.1 Boot Device Priority Submenu

To access this menu, select Boot on the menu bar and then Boot Devices Priority.

Maintenance	Main	Advanced	Security	Power	**Boot**	Exit
					Boot Device Priority	
					Hard Disk Drives	
					Removable Devices	
					ATAPI CD-ROM Drives	

The submenu represented in Table 43 is for setting boot devices priority.

Table 43. Boot Device Priority Submenu

Feature	Options	Description
1st Boot Device 2nd Boot Device 3rd Boot Device 4th Boot Device	• Removable Dev. • Hard Drive • ATAPI CD-ROM • Intel® Boot Agent (Note) • Disabled	Specifies the boot sequence according to the device type. The computer will attempt to boot from up to five devices as specified here. Only one of the devices can be an IDE hard disk drive. To specify boot sequence: 1. Select the boot device with <↑> or <↓>. 2. Press <Enter> to set the selection as the intended boot device. The default settings for the first through fourth boot devices are, respectively: • Removable Dev. • Hard Drive • ATAPI CD-ROM • Intel Boot Agent

Note: The boot device identifier for Intel Boot Agent (IBA) may vary depending on the BIOS release.

4.7.2 Hard Disk Drives Submenu

To access this menu, select Boot on the menu bar and then Hard Disk Drives.

Maintenance	Main	Advanced	Security	Power	**Boot**	Exit
					Boot Device Priority	
					Hard Disk Drives	
					Removable Devices	
					ATAPI CD-ROM Drives	

The submenu represented in Table 44 is for setting hard disk drive priority.

Table 44. Hard Disk Drives Submenu

Feature	Options	Description
1st Hard Disk Drive (Note)	Dependent on installed hard drives	Specifies the boot sequence from the available hard disk drives. To specify boot sequence: 1. Select the boot device with <↑> or <↓>. 2. Press <Enter> to set the selection as the intended boot device.

Note: This boot device submenu appears only if at least one boot device of this type is installed. This list will display up to twelve hard disk drives, the maximum number of hard disk drives supported by the BIOS.

4.7.3 Removable Devices Submenu

To access this menu, select Boot on the menu bar, then Removable Devices.

Maintenance	Main	Advanced	Security	Power	**Boot**	Exit
					Boot Device Priority	
					Hard Disk Drives	
					Removable Devices	
					ATAPI CD-ROM Drives	

The submenu represented in Table 45 is for setting removable device priority.

Table 45. Removable Devices Submenu

Feature	Options	Description
1st Removable Device (Note)	Dependent on installed removable devices	Specifies the boot sequence from the available removable devices. To specify boot sequence: 1. Select the boot device with <↑> or <↓>. 2. Press <Enter> to set the selection as the intended boot device.

Note: This boot device submenu appears only if at least one boot device of this type is installed. This list will display up to four removable devices, the maximum number of removable devices supported by the BIOS.

4.7.4 ATAPI CD-ROM Drives Submenu

To access this menu, select Boot on the menu bar and then ATAPI CD-ROM Drives.

Maintenance	Main	Advanced	Security	Power	**Boot**	Exit
					Boot Device Priority	
					Hard Disk Drives	
					Removable Devices	
					ATAPI CD-ROM Drives	

The submenu represented in Table 46 is for setting ATAPI CD-ROM drive priority.

Table 46. ATAPI CD-ROM Drives Submenu

Feature	Options	Description
1st ATAPI CDROM (Note)	Dependent on installed ATAPI CD-ROM drives	Specifies the boot sequence from the available ATAPI CD-ROM drives. To specify boot sequence: 1. Select the boot device with <↑> or <↓>. 2. Press <Enter> to set the selection as the intended boot device.

Note: This boot device submenu appears only if at least one boot device of this type is installed. This list will display up to four ATAPI CD-ROM drives, the maximum number of ATAPI CD-ROM drives supported by the BIOS.

4.8 Exit Menu

To access this menu, select Exit from the menu bar at the top of the screen.

Maintenance	Main	Advanced	Security	Power	Boot	**Exit**

The menu represented in Table 47 is for exiting the BIOS Setup program, saving changes, and loading and saving defaults.

Table 47. Exit Menu

Feature	Description
Exit Saving Changes	Exits and saves the changes in CMOS SRAM.
Exit Discarding Changes	Exits without saving any changes made in the BIOS Setup program.
Load Optimal Defaults	Loads the optimal default values for all the Setup options.
Load Custom Defaults	Loads the custom defaults for Setup options.
Save Custom Defaults	Saves the current values as custom defaults. Normally, the BIOS reads the Setup values from flash memory. If this memory is corrupted, the BIOS reads the custom defaults. If no custom defaults are set, the BIOS reads the factory defaults.
Discard Changes	Discards changes without exiting Setup. The option values present when the computer was turned on are used.

5 Error Messages and Beep Codes

5.1 BIOS Error Messages

Table 48 lists the error messages and provides a brief description of each.

Table 48. BIOS Error Messages

Error Message	Explanation
GA20 Error	An error occurred with Gate A20 when switching to protected mode during the memory test.
Pri Master HDD Error Pri Slave HDD Error Sec Master HDD Error Sec Slave HDD Error	Could not read sector from corresponding drive.
Pri Master Drive - ATAPI Incompatible Pri Slave Drive - ATAPI Incompatible Sec Master Drive - ATAPI Incompatible Sec Slave Drive - ATAPI Incompatible	Corresponding drive in not an ATAPI device. Run Setup to make sure device is selected correctly.
A: Drive Error	No response from diskette drive.
Cache Memory Bad	An error occurred when testing L2 cache. Cache memory may be bad.
CMOS Battery Low	The battery may be losing power. Replace the battery soon.
CMOS Display Type Wrong	The display type is different than what has been stored in CMOS. Check Setup to make sure type is correct.
CMOS Checksum Bad	The CMOS checksum is incorrect. CMOS memory may have been corrupted. Run Setup to reset values.
CMOS Settings Wrong	CMOS values are not the same as the last boot. These values have either been corrupted or the battery has failed.
CMOS Date/Time Not Set	The time and/or date values stored in CMOS are invalid. Run Setup to set correct values.
DMA Error	Error during read/write test of DMA controller.
FDC Failure	Error occurred trying to access diskette drive controller.
HDC Failure	Error occurred trying to access hard disk controller.
Checking NVRAM.....	NVRAM is being checked to see if it is valid.
Update OK!	NVRAM was invalid and has been updated.
Updated Failed	NVRAM was invalid but was unable to be updated.
Keyboard Error	Error in the keyboard connection. Make sure keyboard is connected properly.
KB/Interface Error	Keyboard interface test failed.

continued

Table 48. BIOS Error Messages (continued)

Error Message	Explanation
Memory Size Decreased	Memory size has decreased since the last boot. If no memory was removed then memory may be bad.
Memory Size Increased	Memory size has increased since the last boot. If no memory was added there may be a problem with the system.
Memory Size Changed	Memory size has changed since the last boot. If no memory was added or removed then memory may be bad.
No Boot Device Available	System did not find a device to boot.
Off Board Parity Error	A parity error occurred on an off-board card. This error is followed by an address.
On Board Parity Error	A parity error occurred in onboard memory. This error is followed by an address.
Parity Error	A parity error occurred in onboard memory at an unknown address.
NVRAM/CMOS/PASSWORD cleared by Jumper	NVRAM, CMOS, and passwords have been cleared. The system should be powered down and the jumper removed.
<CTRL_N> Pressed	CMOS is ignored and NVRAM is cleared. User must enter Setup.

5.2 Port 80h POST Codes

During the POST, the BIOS generates diagnostic progress codes (POST-codes) to I/O port 80h. If the POST fails, execution stops and the last POST code generated is left at port 80h. This code is useful for determining the point where an error occurred.

Displaying the POST-codes requires a PCI bus add-in card, often called a POST card. The POST card can decode the port and display the contents on a medium such as a seven-segment display.

NOTE

The POST card must be installed in PCI bus connector 1.

The tables below offer descriptions of the POST codes generated by the BIOS. Table 49 defines the uncompressed INIT code checkpoints, Table 50 describes the boot block recovery code checkpoints, and Table 51 lists the runtime code uncompressed in F000 shadow RAM. Some codes are repeated in the tables because that code applies to more than one operation.

Table 49. Uncompressed INIT Code Checkpoints

Code	Description of POST Operation
D0	NMI is Disabled. Onboard KBC, RTC enabled (if present). Init code Checksum verification starting.
D1	Keyboard controller BAT test, CPU ID saved, and going to 4 GB flat mode.
D3	Do necessary chipset initialization, start memory refresh, and do memory sizing.
D4	Verify base memory.
D5	Init code to be copied to segment 0 and control to be transferred to segment 0.
D6	Control is in segment 0. To check recovery mode and verify main BIOS checksum. If either it is recovery mode or main BIOS checksum is bad, go to check point E0 for recovery else go to check point D7 for giving control to main BIOS.
D7	Find Main BIOS module in ROM image.
D8	Uncompress the main BIOS module.
D9	Copy main BIOS image to F000 shadow RAM and give control to main BIOS in F000 shadow RAM.

Table 50. Boot Block Recovery Code Checkpoints

Code	Description of POST Operation
E0	Onboard Floppy Controller (if any) is initialized. Compressed recovery code is uncompressed in F000:0000 in Shadow RAM and give control to recovery code in F000 Shadow RAM. Initialize interrupt vector tables, initialize system timer, initialize DMA controller and interrupt controller.
E8	Initialize extra (Intel Recovery) Module.
E9	Initialize floppy drive.
EA	Try to boot from floppy. If reading of boot sector is successful, give control to boot sector code.
EB	Booting from floppy failed, look for ATAPI (LS-120, Zip) devices.
EC	Try to boot from ATAPI. If reading of boot sector is successful, give control to boot sector code.
EF	Booting from floppy and ATAPI device failed. Give two beeps. Retry the booting procedure again (go to check point E9).

Table 51. Runtime Code Uncompressed in F000 Shadow RAM

Code	Description of POST Operation
03	NMI is Disabled. To check soft reset/power-on.
05	BIOS stack set. Going to disable cache if any.
06	POST code to be uncompressed.
07	CPU init and CPU data area init to be done.
08	CMOS checksum calculation to be done next.
0B	Any initialization before keyboard BAT to be done next.
0C	KB controller I/B free. To issue the BAT command to keyboard controller.
0E	Any initialization after KB controller BAT to be done next.
0F	Keyboard command byte to be written.
10	Going to issue Pin-23,24 blocking/unblocking command.
11	Going to check pressing of <INS>, <END> key during power-on.
12	To init CMOS if "Init CMOS in every boot" is set or <END> key is pressed. Going to disable DMA and Interrupt controllers.
13	Video display is disabled and port-B is initialized. Chipset init about to begin.
14	8254 timer test about to start.
19	About to start memory refresh test.
1A	Memory Refresh line is toggling. Going to check 15 µs ON/OFF time.
23	To read 8042 input port and disable Megakey GreenPC feature. Make BIOS code segment writeable.
24	To do any setup before Int vector init.
25	Interrupt vector initialization to begin. To clear password if necessary.
27	Any initialization before setting video mode to be done.
28	Going for monochrome mode and color mode setting.
2A	Different buses init (system, static, output devices) to start if present. (See Section 5.3 for details of different buses.)
2B	To give control for any setup required before optional video ROM check.
2C	To look for optional video ROM and give control.
2D	To give control to do any processing after video ROM returns control.
2E	If EGA/VGA not found then do display memory R/W test.
2F	EGA/VGA not found. Display memory R/W test about to begin.
30	Display memory R/W test passed. About to look for the retrace checking.
31	Display memory R/W test or retrace checking failed. To do alternate Display memory R/W test.
32	Alternate Display memory R/W test passed. To look for the alternate display retrace checking.
34	Video display checking over. Display mode to be set next.
37	Display mode set. Going to display the power-on message.
38	Different buses init (input, IPL, general devices) to start if present. (See Section 5.3 for details of different buses.)
39	Display different buses initialization error messages. (See Section 5.3 for details of different buses.)
3A	New cursor position read and saved. To display the Hit <DEL> message.

continued

Table 51. Runtime Code Uncompressed in F000 Shadow RAM (continued)

Code	Description of POST Operation
40	To prepare the descriptor tables.
42	To enter in virtual mode for memory test.
43	To enable interrupts for diagnostics mode.
44	To initialize data to check memory wrap around at 0:0.
45	Data initialized. Going to check for memory wrap around at 0:0 and finding the total system memory size.
46	Memory wrap around test done. Memory size calculation over. About to go for writing patterns to test memory.
47	Pattern to be tested written in extended memory. Going to write patterns in base 640k memory.
48	Patterns written in base memory. Going to find out amount of memory below 1M memory.
49	Amount of memory below 1M found and verified. Going to find out amount of memory above 1M memory.
4B	Amount of memory above 1M found and verified. Check for soft reset and going to clear memory below 1M for soft reset. (If power on, go to check point # 4Eh).
4C	Memory below 1M cleared. (SOFT RESET) Going to clear memory above 1M.
4D	Memory above 1M cleared. (SOFT RESET) Going to save the memory size. (Go to check point # 52h).
4E	Memory test started. (NOT SOFT RESET) About to display the first 64k memory size.
4F	Memory size display started. This will be updated during memory test. Going for sequential and random memory test.
50	Memory testing/initialization below 1M complete. Going to adjust displayed memory size for relocation/shadow.
51	Memory size display adjusted due to relocation/ shadow. Memory test above 1M to follow.
52	Memory testing/initialization above 1M complete. Going to save memory size information.
53	Memory size information is saved. CPU registers are saved. Going to enter in real mode.
54	Shutdown successful, CPU in real mode. Going to disable gate A20 line and disable parity/NMI.
57	A20 address line, parity/NMI disable successful. Going to adjust memory size depending on relocation/shadow.
58	Memory size adjusted for relocation/shadow. Going to clear Hit <DEL> message.
59	Hit <DEL> message cleared. <WAIT...> message displayed. About to start DMA and interrupt controller test.
60	DMA page register test passed. To do DMA#1 base register test.
62	DMA#1 base register test passed. To do DMA#2 base register test.
65	DMA#2 base register test passed. To program DMA unit 1 and 2.
66	DMA unit 1 and 2 programming over. To initialize 8259 interrupt controller.
7F	Extended NMI sources enabling is in progress.
80	Keyboard test started. Clearing output buffer, checking for stuck key, to issue keyboard reset command.
81	Keyboard reset error/stuck key found. To issue keyboard controller interface test command.
82	Keyboard controller interface test over. To write command byte and init circular buffer.
83	Command byte written, global data init done. To check for lock-key.

continued

Table 51. Runtime Code Uncompressed in F000 Shadow RAM (continued)

Code	Description of POST Operation
84	Lock-key checking over. To check for memory size mismatch with CMOS.
85	Memory size check done. To display soft error and check for password or bypass setup.
86	Password checked. About to do programming before setup.
87	Programming before setup complete. To uncompress SETUP code and execute CMOS setup.
88	Returned from CMOS setup program and screen is cleared. About to do programming after setup.
89	Programming after setup complete. Going to display power-on screen message.
8B	First screen message displayed. <WAIT...> message displayed. PS/2 Mouse check and extended BIOS data area allocation to be done.
8C	Setup options programming after CMOS setup about to start.
8D	Going for hard disk controller reset.
8F	Hard disk controller reset done. Floppy setup to be done next.
91	Floppy setup complete. Hard disk setup to be done next.
95	Init of different buses optional ROMs from C800 to start. (See Section 5.3 for details of different buses.)
96	Going to do any init before C800 optional ROM control.
97	Any init before C800 optional ROM control is over. Optional ROM check and control will be done next.
98	Optional ROM control is done. About to give control to do any required processing after optional ROM returns control and enable external cache.
99	Any initialization required after optional ROM test over. Going to setup timer data area and printer base address.
9A	Return after setting timer and printer base address. Going to set the RS-232 base address.
9B	Returned after RS-232 base address. Going to do any initialization before Coprocessor test.
9C	Required initialization before Coprocessor is over. Going to initialize the Coprocessor next.
9D	Coprocessor initialized. Going to do any initialization after Coprocessor test.
9E	Initialization after Coprocessor test is complete. Going to check extended keyboard, keyboard ID and num-lock.
A2	Going to display any soft errors.
A3	Soft error display complete. Going to set keyboard typematic rate.
A4	Keyboard typematic rate set. To program memory wait states.
A5	Going to enable parity/NMI.
A7	NMI and parity enabled. Going to do any initialization required before giving control to optional ROM at E000.
A8	Initialization before E000 ROM control over. E000 ROM to get control next.
A9	Returned from E000 ROM control. Going to do any initialization required after E000 optional ROM control.
AA	Initialization after E000 optional ROM control is over. Going to display the system configuration.
AB	Put INT13 module runtime image to shadow.
AC	Generate MP for multiprocessor support (if present).
AD	Put CGA INT10 module (if present) in Shadow.

continued

Table 51. Runtime Code Uncompressed in F000 Shadow RAM (continued)

Code	Description of POST Operation
AE	Uncompress SMBIOS module and init SMBIOS code and form the runtime SMBIOS image in shadow.
B1	Going to copy any code to specific area.
00	Copying of code to specific area done. Going to give control to INT-19 boot loader.

5.3 Bus Initialization Checkpoints

The system BIOS gives control to the different buses at several checkpoints to do various tasks. Table 52 describes the bus initialization checkpoints.

Table 52. Bus Initialization Checkpoints

Checkpoint	Description
2A	Different buses init (system, static, and output devices) to start if present.
38	Different buses init (input, IPL, and general devices) to start if present.
39	Display different buses initialization error messages.
95	Init of different buses optional ROMs from C800 to start.

While control is inside the different bus routines, additional checkpoints are output to port 80h as WORD to identify the routines under execution. In these WORD checkpoints, the low byte of the checkpoint is the system BIOS checkpoint from which the control is passed to the different bus routines. The high byte of the checkpoint is the indication of which routine is being executed in the different buses. Table 53 describes the upper nibble of the high byte and indicates the function that is being executed.

Table 53. Upper Nibble High Byte Functions

Value	Description
0	func#0, disable all devices on the bus concerned.
1	func#1, static devices init on the bus concerned.
2	func#2, output device init on the bus concerned.
3	func#3, input device init on the bus concerned.
4	func#4, IPL device init on the bus concerned.
5	func#5, general device init on the bus concerned.
6	func#6, error reporting for the bus concerned.
7	func#7, add-on ROM init for all buses.

Table 54 describes the lower nibble of the high byte and indicates the bus on which the routines are being executed.

Table 54. Lower Nibble High Byte Functions

Value	Description
0	Generic DIM (Device Initialization Manager)
1	On-board System devices
2	ISA devices
3	EISA devices
4	ISA PnP devices
5	PCI devices

5.4 Speaker

A 47 Ω inductive speaker is mounted on the desktop board. The speaker provides audible error code (beep code) information during POST.

5.5 BIOS Beep Codes

Whenever a recoverable error occurs during POST, the BIOS displays an error message describing the problem (see Table 55). The BIOS also issues a beep code (one long tone followed by two short tones) during POST if the video configuration fails (a faulty video card or no card installed) or if an external ROM module does not properly checksum to zero.

An external ROM module (for example, a video BIOS) can also issue audible errors, usually consisting of one long tone followed by a series of short tones. For more information on the beep codes issued, check the documentation for that external device.

There are several POST routines that issue a POST terminal error and shut down the system if they fail. Before shutting down the system, the terminal-error handler issues a beep code signifying the test point error, writes the error to I/O port 80h, attempts to initialize the video and writes the error in the upper left corner of the screen (using both monochrome and color adapters).

If POST completes normally, the BIOS issues one short beep before passing control to the operating system.

Table 55. Beep Codes

Beep	Description
1	Refresh failure
2	Parity cannot be reset
3	First 64 KB memory failure
4	Timer not operational
5	Not used
6	8042 GateA20 cannot be toggled
7	Exception interrupt error
8	Display memory R/W error
9	Not used
10	CMOS Shutdown register test error
11	Invalid BIOS (e.g. POST module not found, etc.)